

**TECHNICAL MANUAL**

**USE OF HAND TOOLS**

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## Chapter I

# INTRODUCTION

### 1.1 PURPOSE OF MANUAL

The purpose of this manual is to present detailed information on the use and care of hand tools, and to provide, in one place, the various tables and charts needed by maintenance personnel to aid them in selecting the proper tool for a specific job. Since even the simplest maintenance routine requires the use of tools, familiarity with them and a knowledge of their correct use is important to all field engineers.

### 1.2 SCOPE OF MANUAL

This manual contains a discussion of the tools most frequently used by sector personnel. Well known and commonly used tools are discussed in Chapter II, and special purpose tools are discussed in succeeding chapters. The tables applicable to tools are contained in the appendix.

### 1.3 SAFETY PRACTICES

Hand tools necessary for maintenance can become a source of personal injury when used incorrectly. Throughout this manual, specific safety instructions are indicated for each tool; however, there are several basic rules listed below that apply regardless of the tool being used.

- a. Select the right tool for the job. Us-

ing a file for a pry, a wrench for a hammer, etc., is asking for trouble.

- b. Keep tools in a safe place. Never carry tools in pockets or leave them lying around. Stepping on a round screwdriver, for instance, could cause a bad fall.
- c. Wear safety glasses when soldering or using power hand tools.
- d. Wear safety glasses anytime the hazard of flying particles exists.
- e. Use only authorized maintenance techniques and materials.
- f. Clean up the work area when the job is completed.
- g. Keep soldering irons in the cage supplied when not in actual use.
- h. Know the location of all safety equipment and be familiar with its operation.
- i. Report all accidents, no matter how slight.

While this list is not all inclusive, adherence to these rules will help reduce the possibility of an accident occurring.

Regardless of the type of work to be done, the best safety rules are careful work habits and common sense.



## Chapter II

# COMMON TOOLS

### 2.1 INTRODUCTION

This chapter discusses commonly used tools such as hammers, screwdrivers, pliers, wrenches, etc. Although these tools are familiar to every Field Engineer, quite often they are used incorrectly, resulting in poor quality workmanship; therefore, this chapter will be devoted to reviewing briefly, the care and proper use of these tools.

### 2.2 HAMMERS

Metal-working hammers are divided into two classifications: hard-faced and soft-faced. The hard-faced hammers are made of forged tool steel while the soft-faced hammers are faced (on the pounding surface) with wood, brass, hard rubber, or plastic.

One of the better known hard-faced hammers is the ball peen (fig. 2-1). The name of this hammer was derived from the ball-shaped end which is used to peen (expand or stretch) metal. The ball peen hammer is frequently used to expand the end of a rivet in a hole. The flat-faced end of the hammer is used for tapping punches and chisels or for other rough work. Ball peen hammers are available at the sites in two different sizes (weights): eight ounces and twenty-four ounces. The type of work being done should determine which of these two weights to use.

Soft-faced hammers are used to form soft metals or to drive close-fitted parts together. Since the soft material on the face of these hammers can be damaged easily, they should not be used for rough work such as driving punches, nails, or bolts. Mallets are also available at the sites. The only difference between a mallet and a soft-faced hammer is that the entire head of a mallet is composed of rubber, brass, or plastic while only the face of a soft-faced hammer is composed of these materials.

#### 2.2.1 Using the Hammer

When using a hammer, it should be gripped close to the free end of the handle. If the handle is gripped close to the head, the force of the blow is

reduced, and it is difficult to hold the hammer head in proper position. The handle should be grasped as in shaking hands. When the blow is struck, the elbow (not the wrist) should be used as a pivot. If the forearm is used as an extension of the handle, the blow will be more effective, and the radius of the swing will be longer, resulting in greater accuracy. Whenever possible, the object should be struck with the full face of the hammer, with the hammer face parallel to the work. This spreads the force of the blow over a greater area and prevents damage to the face of the hammer and, at the same time, minimizes the chance of defacing the material with hammer marks.

Hammer and mallet handles are made of tough, elastic hickory. They are designed for hard usage but can split easily when used as prying bars or for pounding. When obtaining a hammer from the stockroom, check it for the following points:

- a. Is the head mounted securely on the handle?
- b. Is the face of the hammer free from chips or burrs?
- c. Is it clean and free of rust?

A hammer containing any of these defects may result in personal injury and should be returned to the stockroom for repair or replacement.

### 2.3 SCREWDRIVERS

A screwdriver is a tool designed for ONE specific purpose, that is, to loosen or tighten screws. The screwdriver was not designed for use as a crowbar, bottle opener, voltage checking device, etc. However, the screwdriver is quite often used for these purposes, and this is the reason there are so many with broken tips and bent shanks.

#### 2.3.1 Standard Screwdrivers

Standard screwdrivers are available at the sites in lengths up to ten inches, (fig. 2-2). The length is measured from the end of the blade to the

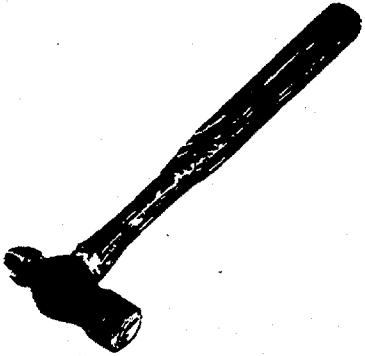
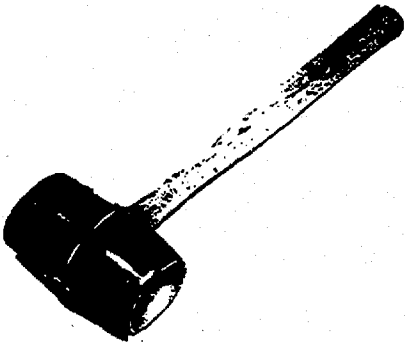
	<p>BALL PEEN HAMMER</p> <table> <tr> <th>Size</th><th>P/N</th></tr> <tr> <td>8 oz.</td><td>3287720</td></tr> <tr> <td>24 oz.</td><td>3287721</td></tr> </table>	Size	P/N	8 oz.	3287720	24 oz.	3287721
Size	P/N						
8 oz.	3287720						
24 oz.	3287721						
	<p>RUBBER MALLET</p> <p>P/N 3287727</p> <p>1 1/4 lb. - Black Daisey</p>						
Empty section for additional hammers and mallets							

FIGURE 2-1. HAMMERS AND MALLETS


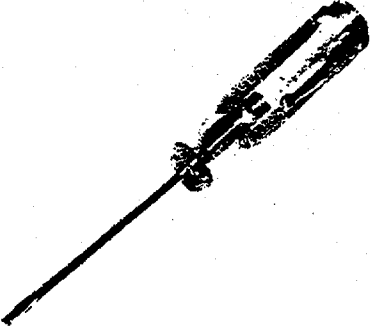
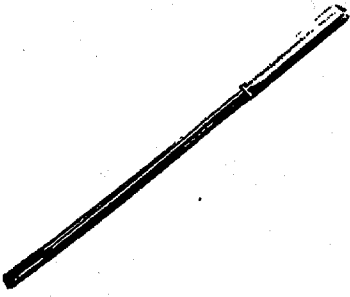
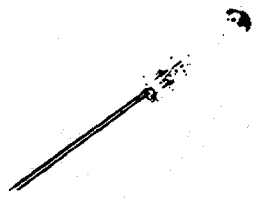
	<p>1 1/2 INCH STUB SCREWDRIVER</p> <p>P/N 3287730</p>
	<p>3 3/4 INCH (THIN BLADE)</p> <p>P/N 3135041</p>
	<p>SCREW STARTER (9 1/4 INCH)</p> <p>P/N 3287766</p>
	<p>6 INCH (INSULATED SHANK)</p> <p>P/N 3287752</p>

FIGURE 2-2. SCREWDRIVERS

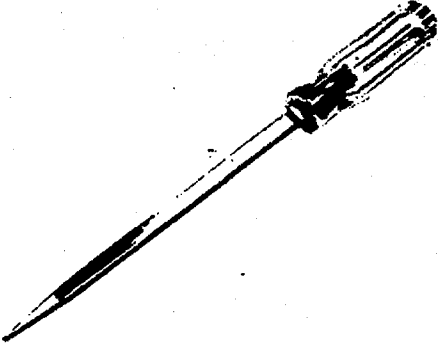
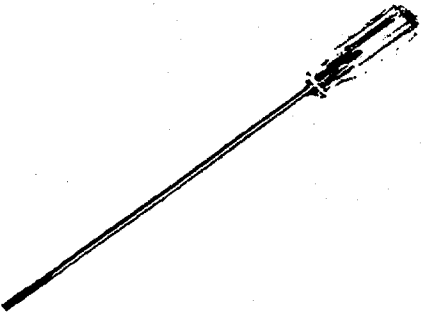
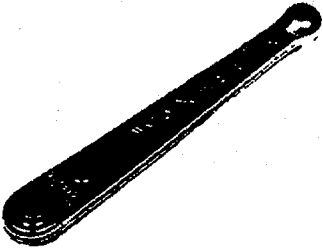
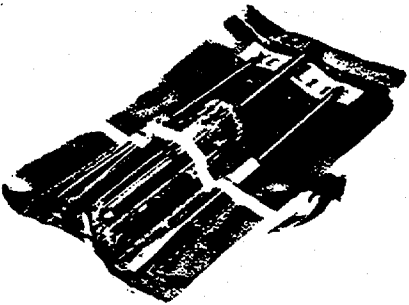
	<p>7 INCH (SQUARE SHANK)</p> <p>P/N 3287751</p>
	<p>10 INCH</p> <p>P/N 3287754</p>
	<p>OFFSET RATCHET SCREWDRIVER</p> <p>P/N 3033384</p> <p>Ratchet Action - Twin Blades</p>
	<p>SCREWDRIVER KIT</p> <p>P/N 3287747</p> <p>Handle and 3 Blades (3 Phillips 3 Standard)</p>

FIGURE 2-2. SCREWDRIVERS (cont'd)

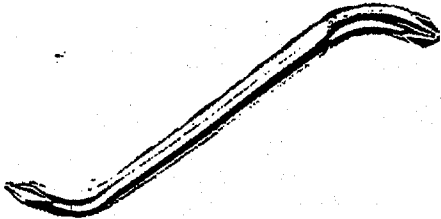
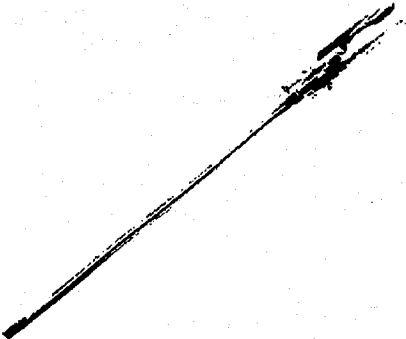
	<p>OFFSET PHILLIPS SCREWDRIVER</p> <p>P/N 3034822</p>
	<p>4 INCH</p> <p>P/N 3287750</p> <p>Used with Keypunch Socket Wrench P/N 3034764</p>
Empty space for additional tools	

FIGURE 2-2. SCREWDRIVERS (cont'd)

handle. The larger of these screwdrivers usually has a thick, square shank so that a wrench can be used to turn it. However, a wrench should never be used on screwdrivers with thin, round shanks.

### 2.3.2 Phillips Screwdrivers

The Phillips screwdriver has a specially shaped blade that fits only Phillips screws. The heads of these screws have a four-way slot that prevents the screwdriver from slipping. When using the Phillips screwdriver, caution should be exercised to insure that the proper size screwdriver is used since the blade of the driver and the screw slot can be damaged easily. There are three standard sizes of Phillips screwdrivers, illustrated in figure 2-2, which can be used on a wide range of screws.

### 2.3.3 Offset Screwdrivers

The offset screwdriver (fig. 2-2) is used, primarily, when the screw head is almost inaccessible. It is difficult to handle because the blade has a tendency to slip out of the screw slot if care is not exercised. The two blades of this screwdriver are made at right angles to each other in order that a screw can be turned a quarter turn at a time by using the opposite ends of the screwdriver alternately.

### 2.3.4 Ratchet Screwdrivers

Ratchet screwdrivers (fig. 2-2) are similar to offset screwdrivers in that they are used when the screw head is located in an area where a standard screwdriver will not fit. The ratchet screwdriver, however, is designed so that once the blade is inserted into the screw slot, the screw can be turned completely out or in by utilizing the ratchet action without removing and reinserting the driver blade for each turn of the screw. Ratchet direction of this type screwdriver is controlled by a small lever on the handle of the screwdriver.

### 2.3.5 Screw Starter

Occasionally a screw will have to be installed or removed in an area where it is difficult to reach the screw. When this occurs a screw starter (fig. 2-2) should be used. This tool has a spring-loaded, expandable point that can be inserted into the screw slot and expanded to a tight fit, enabling personnel to insert the screw into the hole. The screw starter should not be used to drive a screw in tight of to loosen a screw because the spring-loaded point is weak and will snap or slip when excessive torque is applied.

### 2.3.6 Use of Screwdrivers

The following rules should always be observed

in using and handling screwdrivers:

- a. Never use a screwdriver to check electrical circuits.
- b. Never hold the work in your hand when using a screwdriver; it may slip.
- c. Never have any part of your body in front of the blade when using the screwdriver; it may slip and result in personal injury.
- d. Never use a screwdriver as a prying bar or chisel. Use the proper tool.
- e. Never use a standard screwdriver on Phillips or Reed and Prince screw.
- f. Never carry a screwdriver in your pocket.
- g. Don't return a defective screwdriver to the stockroom without informing the stock clerk.
- h. Select the proper size driver for the job. Use the largest screwdriver that fits snugly into the screw slot.
- i. Select the length of screwdriver that will properly line up with screw slot.
- j. Never insert the driver at an angle. Select a shorter screwdriver if necessary.

## 2.4 FILES

A file is a precisely made tool of hardened steel with cutting edges across the surface. It is used for cutting, smoothing, and removing small amounts of metal. The terms commonly used to describe a file are illustrated in figure 2-3.

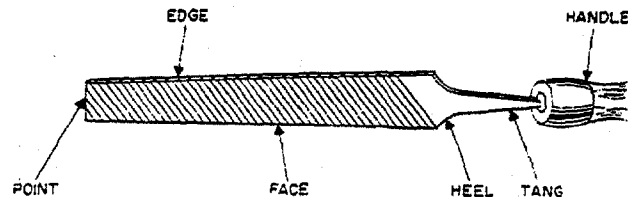


FIGURE 2-3. FILE TERMINOLOGY

Files come in various shapes, lengths, and grades of cut. The type of work being done will determine which file to use. In selecting a file for a particular job, first consider the shape of file desired. Some of the different file shapes are illustrated in figure 2-4.

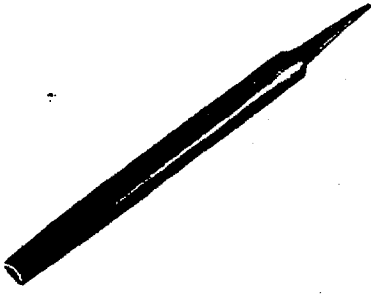

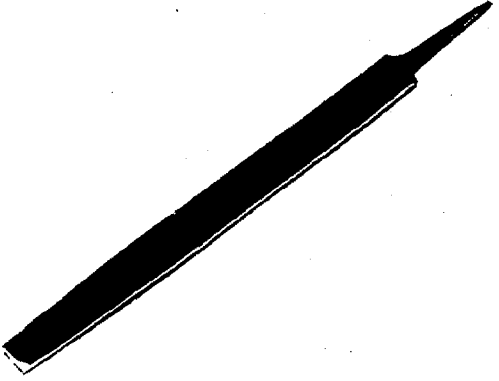

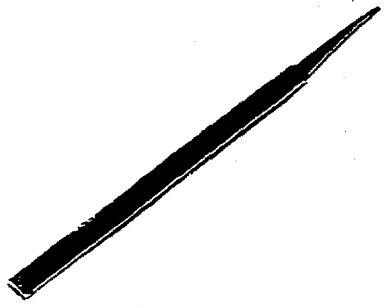

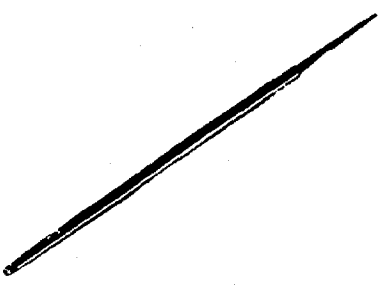

	<p>P/N 3287701 - 6" HALF ROUND</p>  <p>END VIEW</p>
	<p>P/N 3287702 - 6" MILL</p>  <p>END VIEW</p>
	<p>P/N 3287703 - 6" PILLAR</p>  <p>END VIEW</p>
	<p>P/N 3287704 - 6" ROUND</p>  <p>END VIEW</p>

FIGURE 2-4. FILES

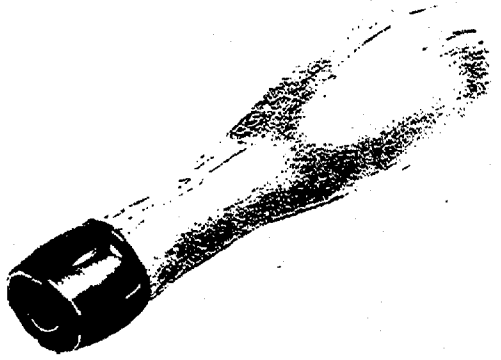

	FILE HANDLE  P/N 3079554	
	3287717 - SWISS PATTERN FILE SET  P/N 3287705 - 16 (length 7" with 5" cutting face)	
<u>P/N</u>	<u>TYPE</u>	<u>END VIEW</u>
3287705	Round 1/4"	●
3287706	Square 1/4"	■
3287707	Pillar 1/4" x 1/8"	—
3287708	Crochet 1/4" x 1/8"	⊖
3287709	Half round 17/16" x 1/8"	◐
3287710	3 Square (triangular) 11/64"	▲
3287711	Pippen 7/32" x 3/32"	◑
3287712	Lozenge 9/32" x 5/32"	◆
3287713	Cant 13/32" x 5/32"	◄
3287714	Knife 3/8" x 3/32"	◄
3287715	Equalling 1/4" x 1/8"	■
3287716	Oval 1/4" x 5/32"	◌

FIGURE 2-4. FILES (cont'd)

The half round file is a general purpose file. The rounded side is used for curved surfaces and the flat side for flat surfaces.

Mill files are tapered in both width and thickness. They are used primarily for precision work where a smooth finish is desired. Mill files are available without teeth cut in one edge; this is called the safe edge. The safe edge is included on some files so that when close work is being done, the file will not damage areas adjacent to the work.

Pillar files are used for filing slots and keyways and for filing work in close quarters. One or both of the edges are without cutting teeth (safe edge).

Round files are similar to mill files except that their cross-section is round. These files are used mainly for enlarging round holes. In the smaller sizes they are sometimes called rat-tail files.

Swiss pattern files are small, delicate files used for work on instrument and delicate mechanisms. They come in kits of 12 files of assorted sizes and shapes, and they should be handled carefully because they break easily.

#### 2.4.1 Cuts and Grades of Files

Files have either single-cut or double-cut teeth. Single-cut files have rows of teeth cut parallel to each other while double-cut files have criss-cross rows of teeth. The single-cut files are for fine, detailed work, and the double-cut files are used for quick removal of metal and for rough work. Files are also graded according to the spacing and size of teeth. These various grades are illustrated in figure 2-5.

#### 2.4.2 Use of Files

A file should not be used without a handle because the tang of the file is sharp and can be driven into the hand if the file is suddenly caught on the spur of metal. To install a handle on the file, insert the tang into the handle and with gentle pressure, twist the handle clockwise until the handle is seated. Be sure the handle is on straight and fits snugly before using the file.

When using a file, the stroke is started with light pressure near the point of the file. As the file is pushed across the surface increase the pressure. Pressure should not be applied on the return stroke. Each stroke should be slow and steady. Excessive speed causes the file to rock, resulting in rounded corners. Too much pressure bends the file and also results in rounded corners (fig. 2-6).

When filing flat stock, occasionally change the direction of the file to insure a smooth, even job.

Round objects should be filed with a swinging motion as illustrated in figure 2-7.

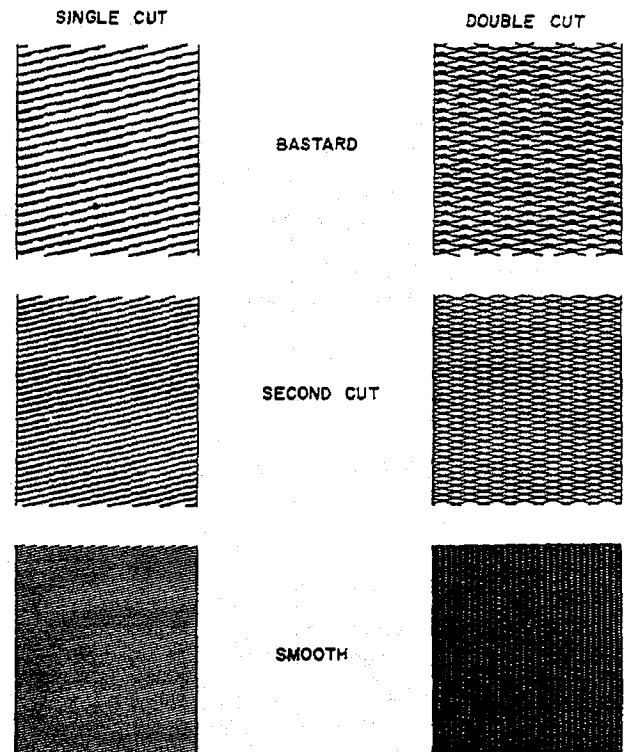


FIGURE 2-5. CUTS AND GRADES OF FILES

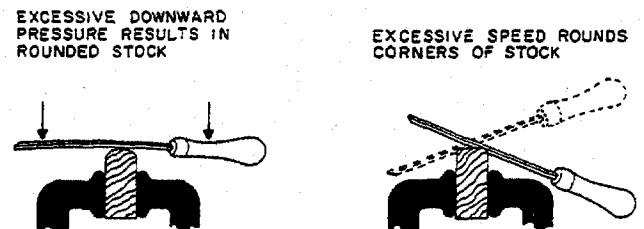


FIGURE 2-6. EFFECTS OF SPEED AND PRESSURE WHEN FILING

To obtain a very smooth surface, draw-file the work with a single-cut, smooth file as illustrated in figure 2-8. For filing inside curved surfaces, use a file whose curve most nearly matches the curvature of the work.

#### 2.4.3 Care of Files

Files are very brittle and are never to be hammered or used as prying bars. Store files in the proper rack. Never store them in a drawer without separators or wrapping to protect the file sur-

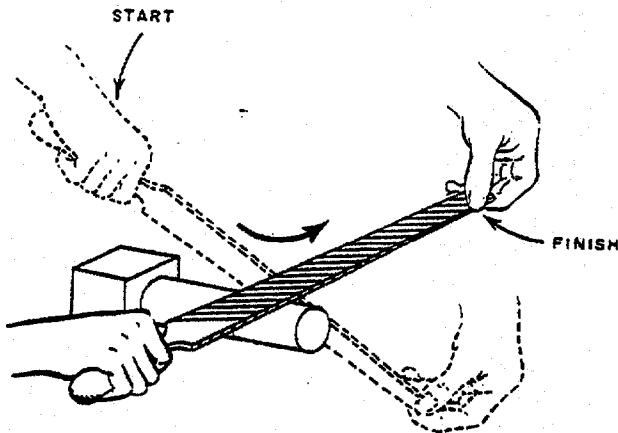


FIGURE 2-7. FILING ROUNDED OBJECTS

face.

- a. Keep files dry to prevent rusting.
- b. Keep the teeth of the file clean. Brush the metal filings from the teeth.
- c. Never strike the file against a surface to clean it. This ruins the teeth and could possibly break the file.
- d. Insure that the file handle is properly installed before using the file.
- e. Apply long, steady, and uniform strokes when using the file. Don't use excessive pressure or speed. Raise the file on the return stroke.
- f. Never lubricate a file.
- g. Use the file recommended for the job.
- h. Secure the work to prevent vibration.

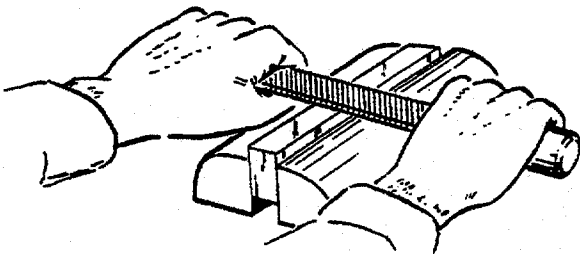


FIGURE 2-8. DRAW FILING

## 2.5 PUNCHES

Punches come in a variety of sizes and shapes

(approximately thirty different types at each site) and are used for many different purposes. The thirty types of punches available are divided into three specific categories: center punches, pin punches, and chassis punches (fig. 2-9).

### 2.5.1 Center Punch

The center punch is used to mark a location that is to be drilled. Besides marking the drilling location, the indentation made with the punch helps prevent the drill from "walking" away from the desired location. This punch should never be used to remove taper pins; the sharp point could slip and wedge between the pin and the hole.

### 2.5.2 Pin Punch

Pin punches, which have flat points, are used to remove taper pins, cotter pins, etc. The punch selected to drive the pin should be the largest possible size that will fit the hole. Always strike the pin punch a sharp, solid blow rather than a series of light blows. This frees the pin without peening the end of the taper pin. When removing the pin, insure that the shaft containing the pin is secured and not free to vibrate. The pin punch can also be used to align holes in different sheets of metal.

### 2.5.3 Repairman's Brass Rods

A punch should not be used to insert taper pins or cotter pins. Punches are made of tool steel and may possiblypeen the end of the pin. Repairman's brass rods are to be used to drive taper pins into place. Brass, being a softer metal than steel, will have less tendency topeen the end of the taper pin.

### 2.5.4 Chassis Punch

Chassis punches are used to cut holes in metal. They are available in sizes from 1/2 inch to 2-1/4 inches in diameter. These punches are also available in two different shapes, round and D-shape. D-shaped punches are used primarily for jobs where the item inserted into the hole should not turn; for example, as in cutting a hole for module door locks.

When using the chassis punch, a clearance hole slightly larger than the driver bolt must be drilled and the punch mounted so that the female section is located on the inside or back of the work (fig. 2-10). This is done so that the burrs that form on the female side of the metal will not project out the front of the work. When the punch is mounted correctly, it can then be driven by using a proper size wrench. The drive screw should be lubricated with a heavy weight grease prior to using the punch.

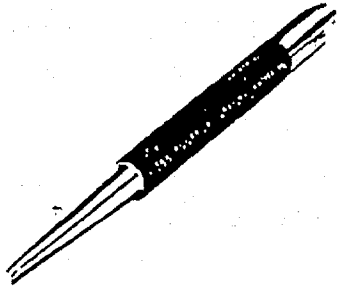
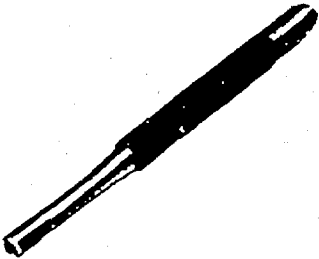
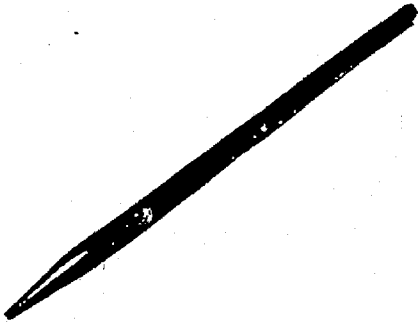
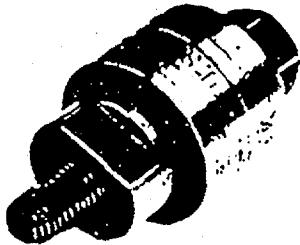
	<p>CENTER PUNCH</p> <p>P/N 3033362</p> <p>Point Dimensions - 0.094 in.</p>
	<p>TAPER PIN PUNCH</p> <p>P/N 3033363 - 0.050 in.</p> <p>P/N 3033360 - 0.0625 in.</p> <p>P/N 3033361 - 0.094 in.</p> <p>P/N 3033359 - 0.187 in.</p>
	<p>TAPER PIN PUNCH (LONG)</p> <p>P/N 3033443 - 18 in. small</p> <p>P/N 3033444 - 18 in. medium</p> <p>P/N 3033445 - 18 in. large</p>
	<p>CHASSIS PUNCH</p> <p>Refer to Appendix Table 15</p>

FIGURE 2-9. PUNCHES AND RODS

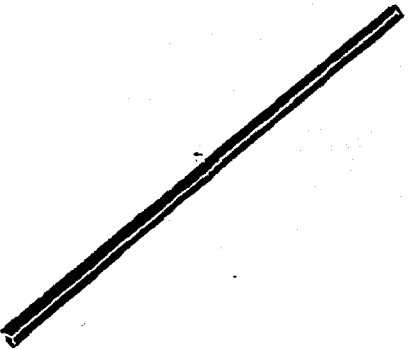
	<p>REPAIRMAN'S RODS</p> <p>P/N 3033358 - 6 in. P/N 3033446 - 20 in.</p>
Empty space for additional items	

FIGURE 2-9. PUNCHES & RODS (cont'd)

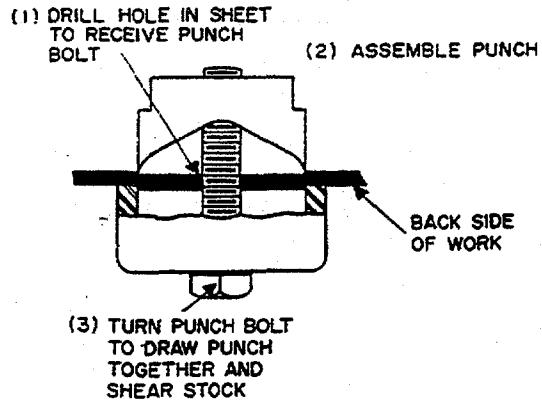


FIGURE 2-10. USE OF THE CHASSIS PUNCH  
2.6 WRENCHES

Fundamentally, the wrench is a tool used to apply a turning force on bolt heads, nuts, and studs. The majority of nuts are six sided and are called hex-nuts, and most wrenches are designed to fit this type of nut. The size of the wrench to use is determined by the size of the wrench jaw opening and the width of the nut. For instance, hex-nuts are measured across opposite flats, and if the nut is measured to be 3/8 inch, the wrench selected should be 3/8 inch wrench. However, the opening between the wrench jaws will actually be slightly larger (.005 inch to .015 inch) in order for the wrench to fit around the nut. When selecting a wrench, be sure that it fits snugly on the nut since improperly fitted wrenches can cause the corners of the nut to become rounded. Figure 2-12 illustrates the wrenches available for site usage.



Exercise caution when pulling or pushing on wrenches. If they must be pushed, do so with an open palm.

#### 2.6.1 Open-End Wrenches

Open-end wrenches are nonadjustable and open on either or both ends of the wrench. They range in size from 3/16 inch to 1 1/4 inch. On the wrenches that utilize both ends, one end will be the next size larger than the other end; i.e., 5/16 inch - 11/32 inch, 3/8 inch - 7/16 inch. The wrench size will be marked on the handle nearest the end to which it corresponds.

Wrenches with small openings will have shorter handles than those with large openings. This portions the leverage of the wrench to the nut and helps prevent damage to the wrench and the work.

The open ends of these wrenches will normally be at a 15° angle with respect to the handle; however, this angle can vary between 0° and 90°. The wrench

opening is placed at an angle to facilitate working in close quarters where there is little space to swing the wrench. This is illustrated in figure 2-11.

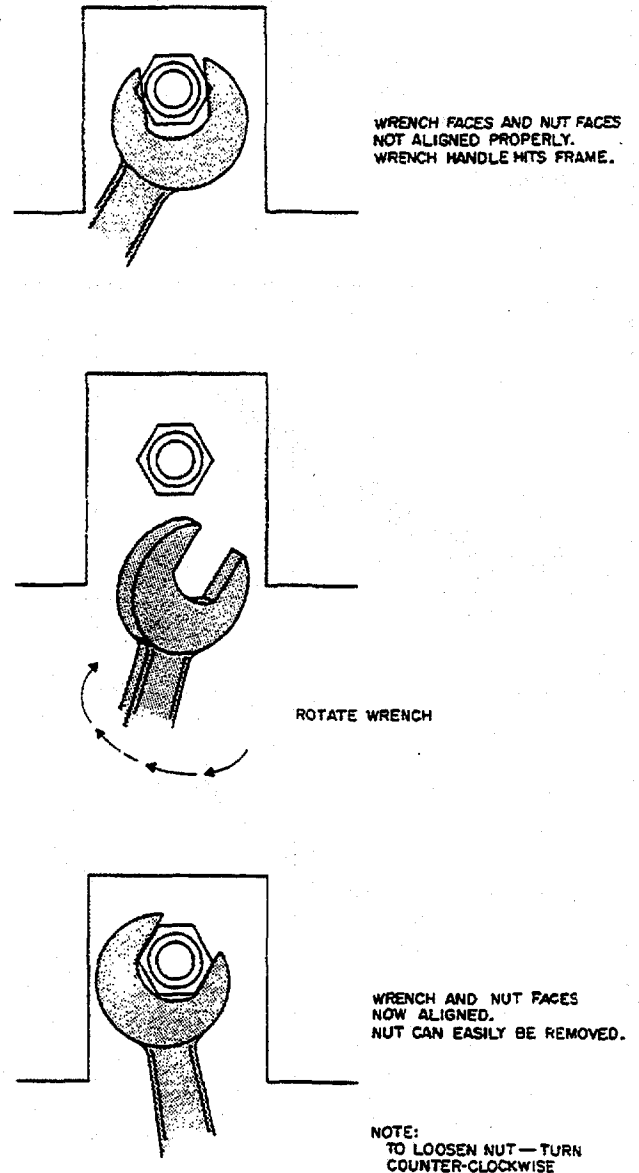


FIGURE 2-11. USE OF ANGLED  
WRENCH OPENING

The handles of these wrenches are often curved or offset to facilitate the removal or insertion of nuts and bolts in recessed or out of the way locations.

#### 2.6.2 Adjustable Wrenches

Open-end wrenches which have one adjustable jaw are called adjustable wrenches. One jaw of this wrench is fixed while the other is adjustable by use of a screw adjustment. This wrench, because it is

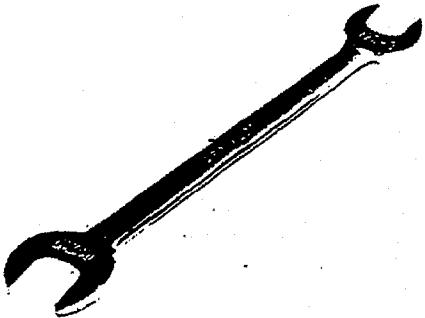
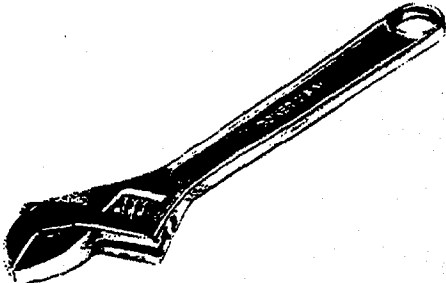
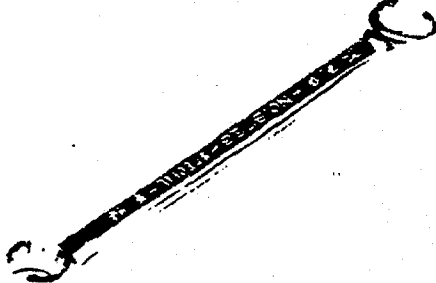
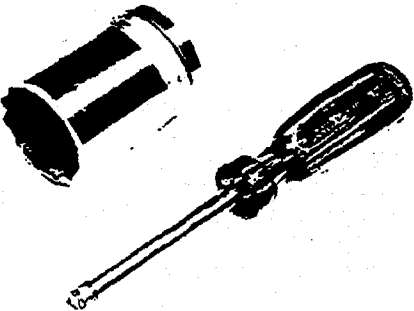
	<p><b>OPEN END</b></p> <p>Refer to Table 9 in the appendix for part number and size.</p>
	<p><b>ADJUSTABLE</b></p> <p>Refer to Table 10 in the appendix for part number and size.</p>
	<p><b>BOX</b></p> <p>Refer to Table 11 in the appendix for part number and size.</p>
	<p><b>SOCKET</b></p> <p>Refer to Tables 12 and 13 in the appendix for part number and size.</p>

FIGURE 2-12. WRENCHES

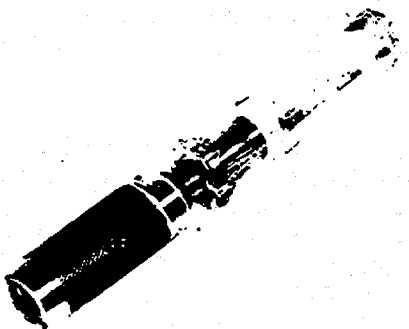
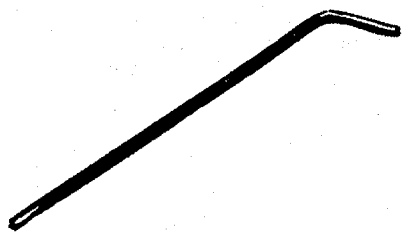
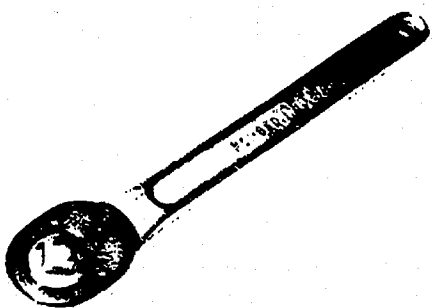

 A black and white photograph of a knurl tight wrench. It has a long, cylindrical handle with a knurled section near the head. The head is a short, thick cylinder with a serrated edge.	<p>KNURL TIGHT WRENCH</p> <p>P/N 3034819</p> <p>Used for removing and installing nuts with serrated edges</p>
 A black and white photograph of a hex and flute tool. It is a long, thin metal rod with a hexagonal section near the head and a flute (a longitudinal groove) along the handle.	<p>HEX AND FLUTE</p> <p>Refer to Table 14 in the appendix for part number and size.</p>
 A black and white photograph of a reversible wrench. It has a long, cylindrical handle with a circular head. The head has a serrated edge and a central opening.	<p>REVERSABLE WRENCH</p> <p>P/N 3204368</p> <p>Used with Caster Jack P/N 3204366</p>
 A black and white photograph of a socket. It is a short, cylindrical metal piece with a hexagonal section in the middle and a flange at one end.	<p>SOCKET</p> <p>P/N 3204367</p> <p>Used with Caster Jack P/N 3204366</p>

FIGURE 2-12. WRENCHES (cont'd)

adjustable, can fit various sized nuts, bolts, and studs; however, the screw adjustment is not strong and should not be used for heavy work. This wrench also has the disadvantage of tending to round off the corners of hex nuts unless its jaws are closely adjusted to fit the nut. Selection and use of this type wrench shall only be when a wrench of proper size is not available.

When using this type of wrench, the strain should be placed on the fixed jaw, not on the movable jaw, to avoid spreading the jaws if too great a force is applied.

### 2.6.3 Box Wrenches

A wrench on which the ends are closed is called a box wrench. The box ends of these wrenches have twelve notches in the box enclosure instead of flat surfaces like the open-end wrench. These notches make it possible to fit this wrench onto hex nuts; that are positioned at angles that an open wrench cannot fit. They can be used with a minimum swing of only fifteen degrees.

The box wrench should be used in place of the open-end wrench to break loose a difficult nut or bolt because, being closed, the jaws will not spread and there is less chance that it will slip off the nut. Once the nut is loose, the open-end wrench will be the best to use, unless there is room to swing the box wrench in a circle. If the working space is limited, the box wrench would have to be lifted off the nut and replaced, which can be difficult to do in some locations.

Box-end wrenches often have a portion of the box end cut out. The size of this cut is a little larger than the screw on which the nut is mounted. This wrench can be used advantageously when the nut is located as illustrated in figure 2-13.

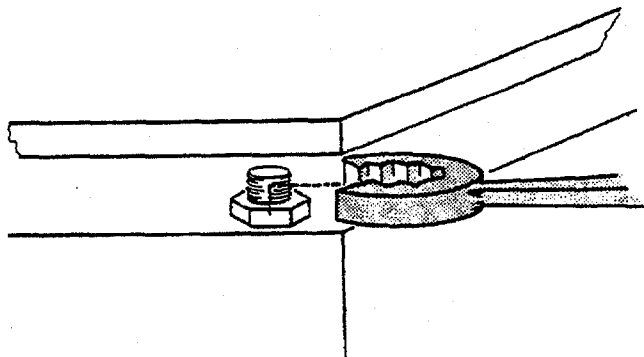


FIGURE 2-13. USE OF A CUT BOX WRENCH

### 2.6.4 Socket Wrenches

Socket wrenches come in a set which includes socket heads of various sizes and several types of

socket handles. The socket heads and handles available at the site are illustrated in figure 2-12. These handles and sockets can be assembled in combinations that will do almost any job quickly and easily.

To use the socket wrench, select the socket head that fits the nut, place the socket head on the handle, and then place it over the nut. The socket head is held on the handle lug by a small friction catch that engages when the socket head and handle are forced together.

### 2.6.5 Hex and Fluted Wrenches

Hex wrenches are used for inserting and removing set screws which have a hollow hex-shaped recess. This wrench is available in sizes from 1/32 inch to 3/8 inch. A special 3/16 inch tee hex wrench is provided for removal of drum assemblies.

The fluted wrench is used for the same purpose as the hex wrench. The fluted wrench has a decided advantage over the hex wrench in that the hex wrench has a tendency to spread the screw recess while the fluted wrench prevents the slot from spreading. These wrenches are available with either 4 or 6 flutes in sizes ranging from 1/8 inch to 1/4 inch.

## 2.7 PLIERS

Pliers can be defined as tools designed to hold parts. They consist of two pieces of steel pivoted near one end. The application of pressure to the ends farthest from the pivot point will produce considerably more pressure at the end near the pivot point. Each of the different types of pliers available at the site is designed for one specific use. They should not be used as hammers or to remove and insert nuts and bolts. Figure 2-14 illustrates the different pliers in use at field installations.

### 2.7.1 Plugging Pliers

Plugging pliers are used to insert and remove electrical taper pins. These pliers have a small slot cut in the jaws designed to grip the taper pin tight enough so that the pin can be inserted into the edge connector terminal without slipping, and at the same time not damage the taper pin or the wire attached to it.

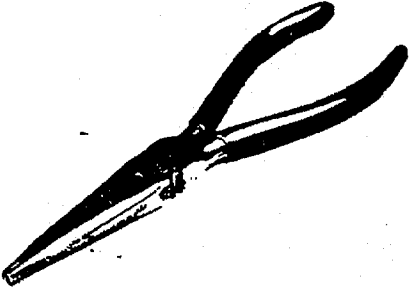
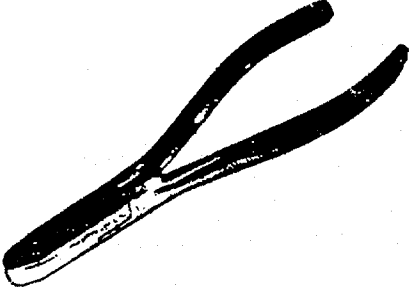
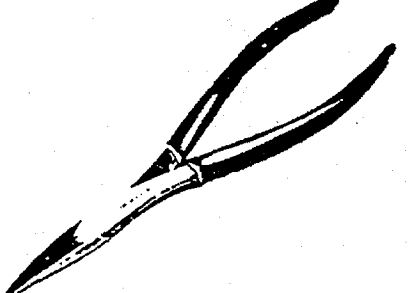

	<p>(PLUGGING (TAPER PIN - INSULATED HANDLE)</p> <p>P/N 3033425</p>
	<p>GAS PLIERS</p> <p>P/N 3079536</p>
	<p>LONG NOSE (INSULATED)</p> <p>P/N 3033486</p>
	<p>NEEDLE NOSE (INSULATED)</p> <p>P/N 3033487</p>

FIGURE 2-14. PLIERS

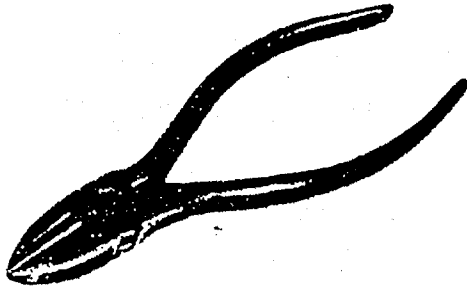
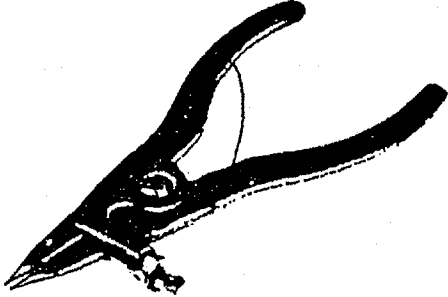

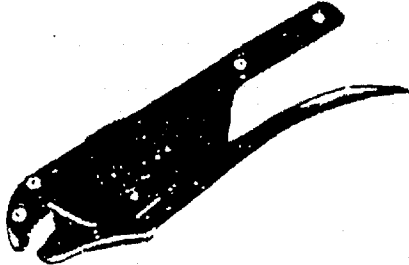
	<p>DIAGONAL CUTTERS</p> <p>P/N 3079533</p>
	<p>TRUARC</p> <p>P/N 3033438</p>
	<p>PLIERS (SPECIAL)</p> <p>P/N 3135037</p> <p>Used when removing retaining rings on the 728 Tape Drives. Refer to M1-20</p>
	<p>WISE GRIP</p> <p>P/N 3287821</p>

FIGURE 2-14. PLIERS (cont'd)

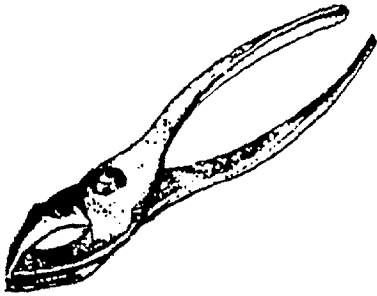
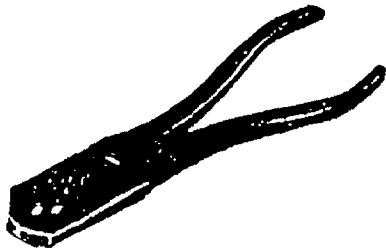
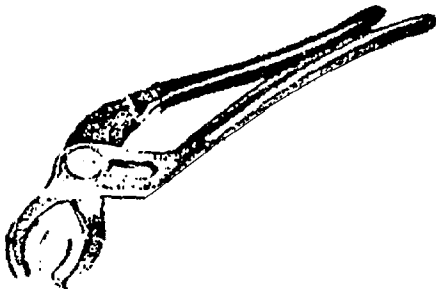
	<p>TURN-LOCK STUD PLIERS</p> <p>P/N 3214894</p>
	<p>CONTACT STAKING PLIERS</p> <p>P/N 3033451</p>
<p>GRAPHIC UNAVAILABLE</p>	<p>BOMARC INTERLOCK PLIERS</p> <p>P/N 3137778</p> <p>Used to crimp seals on interlocked MI modules</p>
	<p>CONNECTOR PLIERS</p> <p>P/N 3204490</p> <p>Used to loosen connectors only</p>

FIGURE 2-14. PLIERS (cont'd)

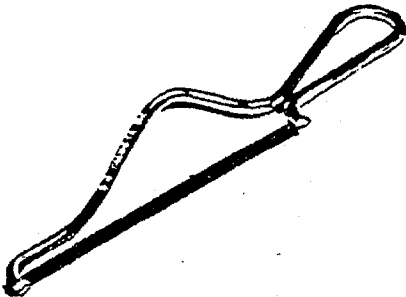
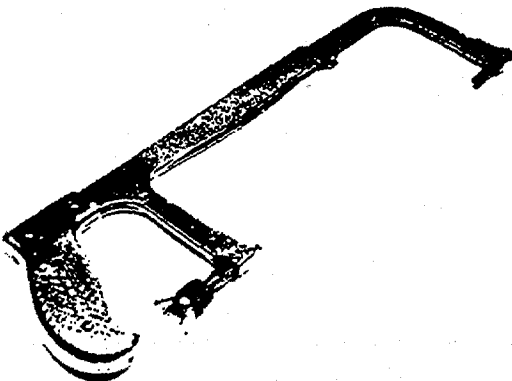


	<p>SMALL</p> <p>P/N 3033547</p>
	<p>LARGE</p> <p>P/N 3287718</p>
	<p>BLADES (LARGE HANDLE)</p> <p>P/N 3287607 - 24 teeth/in. - Use with P/N 3287718</p> <p>P/N 3287608 - 32 teeth/in. - Use with P/N 3287718</p>
	<p>BLADES (SMALL HANDLE)</p> <p>P/N 3033548 - 32 teeth/in. - Use with P/N 3033547</p>

FIGURE 2-15. HACKSAWS

### 2.7.2 Long Nose and Needle Nose Pliers

These pliers are used for general electrical work when work space is limited and the parts are small in size. Needle nose pliers can also be used to form small loops in a piece of wire prior to connecting the wire to a terminal pin. The jaws of these pliers are weak and should not be used for heavy gripping.

### 2.7.3 Diagonal Cutters

Diagonal cutters are used to cut small size wire and component leads. These pliers can be damaged easily and should not be used to cut nails or similar objects. The wire to be cut should be placed as close to the pivot of the cutting jaws as possible and not at the points. This reduces the tendency to spring the jaws apart. Once the jaws are spread it is difficult to cut small-sized wire. When using diagonal cutters, the inside of the cutting jaws should be pointed away from the user's face to prevent injury from flying clippings.

### 2.7.4 Truarc Pliers

This tool is used to insert and remove snap rings. By inserting the pointed jaws of these pliers into the holes of the snap ring, the ring can be expanded, allowing easy removal or installation. The adjustment screw located on the jaws is used to limit the amount of expansion, preventing excessive spreading of the snap ring.

### 2.7.5 Gas and Vise Grip Pliers

Gas pliers (turning) and vise pliers (holding and turning) are heavy duty pliers that can be used when ample work space is available. The vise-grip pliers are designed with a locking feature that permits the user to lock the pliers on the work. The jaws of these pliers are adjustable to the minimum distance between the jaws when closed and locked.

### 2.7.6 Turnlock Stud Pliers

These pliers are used to insert and remove turnlock stud fasteners. By gripping the fastener with these pliers, the spring assembly of the fastener is compressed, allowing easy installation and removal.

### 2.7.7 Contact Staking Pliers

This tool is used when assembling or making repairs to pluggable unit connectors. The connector retaining ear, which prevents the female contacts from pulling free, is set into position using this tool. To prevent damage to base connector blocks, caution should be exercised not to twist pin while using pliers.

## 2.8 HACKSAWS

The hacksaw is a tool consisting of a frame on which interchangeable saw blades can be mounted. There are two different frames (fig. 2-15) that can be used to hold various size blades. The larger frame has a pistol-grip handle and is adjustable to hold blades of different lengths. The smaller frame has a straight handle and is non-adjustable.

The hacksaw blades for the large frame have holes in both ends and are mounted on the frame by means of two pins, one on each end of the frame. The pin nearest the handle can be adjusted to tighten the blade in the frame once it has been mounted. The blades for the smaller saw have pins on the blade instead of on the frame. The frame has slots cut in both ends into which the blade pins should be inserted.

The hacksaw blade should be mounted with the cutting edges facing away from the handle as illustrated in figure 2-16.

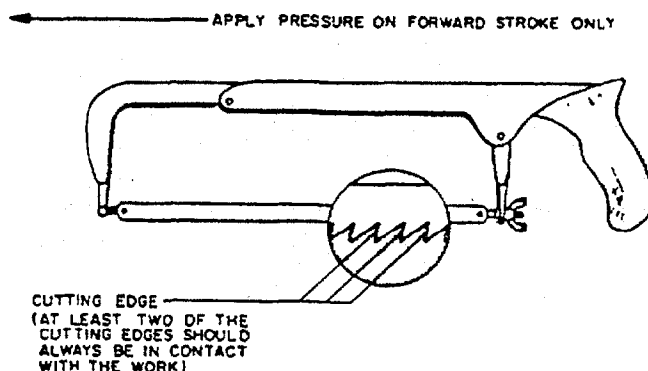


FIGURE 2-16. PROPERLY MOUNTED HACKSAW BLADE

Hacksaw blades are distinguished by the number of teeth per inch. The two most prominent sizes are 24 and 32 teeth per inch. The 24 is used for cutting heavy pipe, brass, copper, etc., and the 32 is used when cutting thin tubing and sheet metal. Work being cut should be mounted in a vise if it is not secured to a unit. To insure an accurate cut, it is advisable to file a notch in the metal prior to cutting. This will prevent the blade from wandering. Once the cutting has started, the saw should be angled in such a manner that at least two teeth are always in contact with the metal, otherwise the blade will jump and damage the cutting teeth. Pressure should be applied on the forward stroke of the saw and not on the return stroke because only the vertical edge of the teeth is ground for cutting. The sloping edge of the teeth does not have a cutting edge, and if pressure is applied while moving the saw in this direction, the edge will wear and tend to round off the teeth.

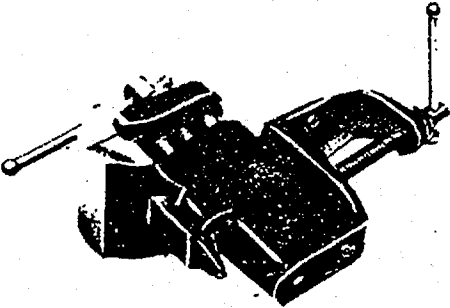
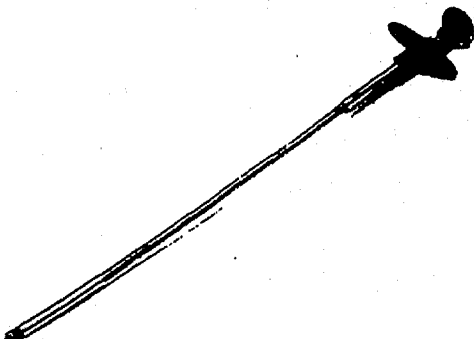

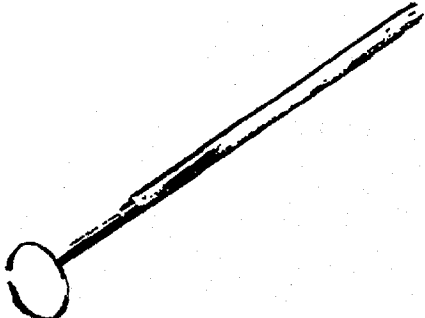
	<p>BENCH VISES</p> <p>P/N 3287796 - Small P/N 3287797 - Large</p>
	<p>RETRIEVER (MECHANICAL FINGERS)</p> <p>P/N 3033495</p>
	<p>SCRIBER</p> <p>P/N 3287761</p>
	<p>INSPECTION MIRROR</p> <p>P/N 3287728</p>

FIGURE 2-17. MISCELLANEOUS COMMON TOOLS


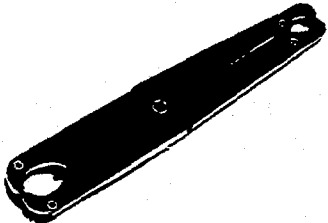
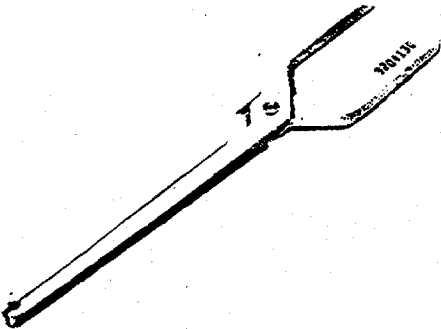
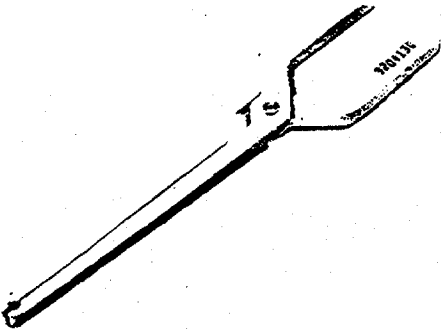
	<p>TWEEZERS</p> <p>P/N 3034604</p>
	<p>BURNISHING BLADE</p> <p>P/N 3034835</p>
	<p>FUSE PULLER</p> <p>P/N 3287731 - short</p>
	<p>FUSE PULLER</p> <p>P/N 3204130 - long</p>

FIGURE 2-17. MISCELLANEOUS COMMON TOOLS (con't)

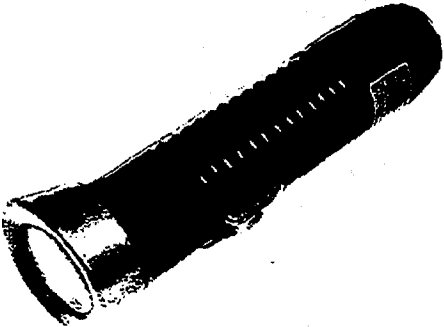

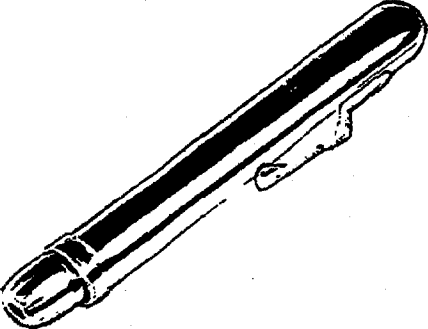
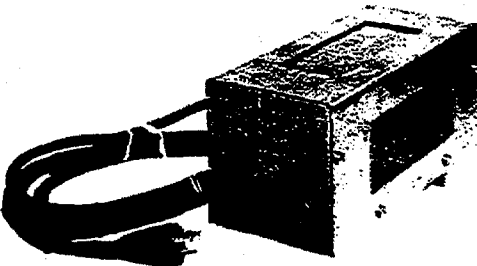
	<p>FLASHLIGHT</p> <p>P/N 3287600</p>
	<p>TROUBLE LIGHT</p> <p>P/N 3287601</p>
	<p>PEN LIGHT</p> <p>P/N 3034615</p>
	<p>GROUND ISOLATION ADAPTOR</p> <p>P/N 3204200</p> <p>Required when using Test Equipment above ground potential</p>

FIGURE 2-17. MISCELLANEOUS COMMON TOOLS (con't)

### 2.8.1 Care of Hacksaws

The following rules should be observed when using hacksaws:

- a. Select the proper size blade for the metal to be cut.
- b. Install the blade properly.
- c. When in use, the blade tension should be great enough to prevent buckling and, conversely, not to such an extent that the blade will snap if the frame is accidentally cocked.
- d. Deleted.
- e. Insure that the work is secured before cutting.
- f. Return all defective or dull blades to the stockroom for repair or replacement.
- g. Wipe the blade with a cloth dampened with a light weight oil before returning it to the stockroom.

### 2.9 MISCELLANEOUS COMMON TOOLS

Listed under this category are the small tools serving special functions whose operation is self explanatory. The purpose of this section is to familiarize the Field Engineer with these tools, illustrated in Figure 2-17.

Each site is supplied with two machinist's vises. When using the vise, two precautions should be taken: Never hammer on the closing handle of the vise; and when working with soft

metals or delicate instruments, the vise jaws should be covered to prevent scratching or damaging the item being held.

The retriever is used to pick up small objects that are located in inaccessible areas.

The scriber is used for marking on metal. It should not be used for marking aluminum; a pencil should be used for this purpose.

An inspection mirror can be used when the work being done is located in such a position that it is out of view. The polished or smooth surface (glass) mirror will be removed from service if imperfections distort the viewed reflection and or the surface is damaged, chipped or cracked. A noninsulated mirror will be used on live (electrical) equipment.

Tweezers are used to pick up small parts. They are very useful when working on delicate instruments utilizing very small screws, nuts, etc.

Burnishing blades are used to smooth relay and cam contacts, brushes, etc. This tool does not remove metal as a file does, but cold-rolls the metal, rearranging the metallic particles and smoothing the surface. Care should be exercised when using this tool because contact surfaces can be damaged to such an extent that replacement is required.

Two different types of fuse pullers are available at the site. The longer of the two is designed for removing and inserting fuses in the core memory array, but can be used elsewhere. The two fuse pullers are provided to cover a wide range of fuse sizes.

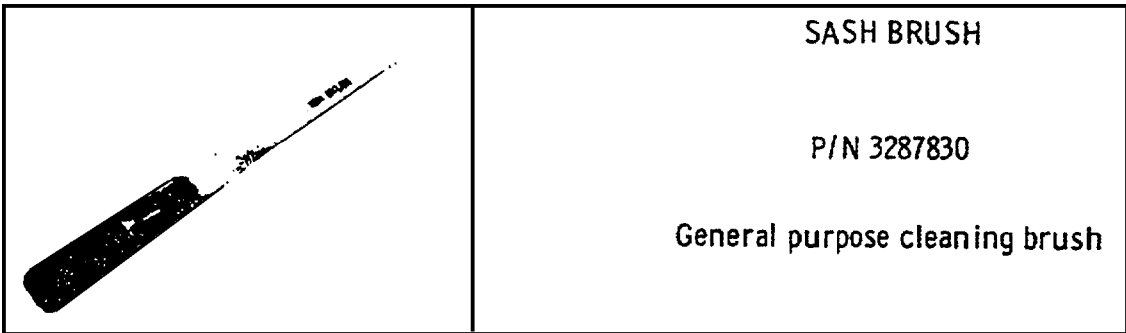


Figure 2-17. MISCELLANEOUS COMMON TOOLS (Sheet 1 of 2)

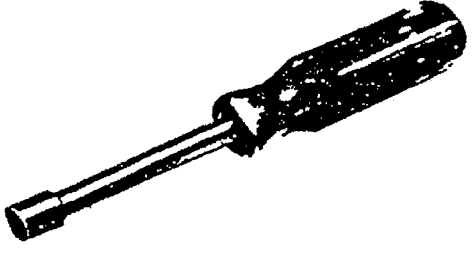


	<p><b>NUT DRIVER</b></p> <p>P/N 3033870 - 3/8 inch  P/N 3033871 - 1/2 inch  P/N 3033872 - 5/8 inch</p>
	<p><b>TERMINAL BRUSH</b></p> <p>P/N 3135047</p> <p>Used to clean foreign materials  from terminals</p>
	<p><b>HORSE SHOE MAGNET</b></p> <p>P/N 3204331</p> <p>Used to secure Isolation Adapter  on Oscilloscope</p>

Figure 2-17. MISCELLANEOUS COMMON TOOLS (Con't)

## Chapter III

### SPECIAL TOOLS

#### 3.1 INTRODUCTION

This chapter deals with the specialized tools such as wire-strippers, crimping tools, bench grinders, etc., that are used at field locations.

#### 3.2 WIRE STRIPPERS

Wire Strippers are used to remove the insulation from wire and coaxial cable. There are three different types of wire strippers used at the site: two are used for wire and the third only for coaxial cables. These strippers are illustrated in figure 3-1. Each stripper is capable of stripping insulation from various sizes of wire. When using the strippers, care must be exercised to insure that the wire size is not larger than the stripper slots since this would result in damage to the wire. If the wire is multiple stranded, several of the strands will be cut; if the wire is a single strand, it will be nicked and weakened to the point where it will break when twisted even slightly.

#### 3.3 CRIMPING TOOLS

There are approximately twenty different types of crimping tools now in use at field locations, each one designed to install a specific type and size of connector. These tools are used to install electrical taper pins, butt connectors, ring tongue terminals, ferrules, etc. The various crimping tools differ in some respects due to different manufacturers; however, they are all marked to indicate manufacturers part number and wire size limitations.

Several of the crimping tools are adjustable to accommodate different insulation thicknesses. This adjustment is accomplished by positioning two pins\* located near the pivot point of the tool. Each of the two pins can be placed in any one of three different locations labeled 1, 2, and 3.

When making adjustment, make sure that both insulation adjustment pins are in the same numbered Positions. Position number 3 is for wire having a large Insulation diameter, position number 2 is for

wire having a medium insulation diameter, and position number 1 is for wire having a small insulation diameter.

Crimping tools are often colored coded. This color will be located either on the handle or on the crimping jaws of the tool. The color indicates the size of wire to be connected. Often the connector is also color coded to match the tool. The color codes normally used are as follows:

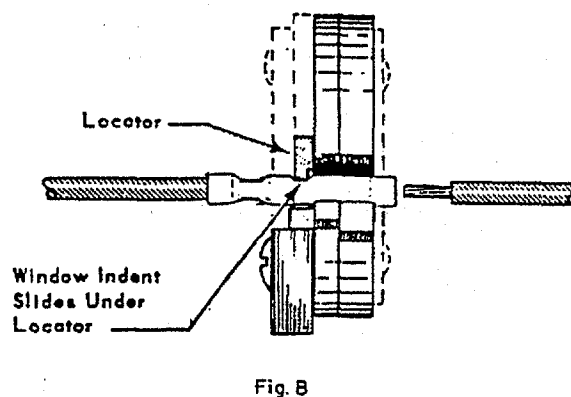
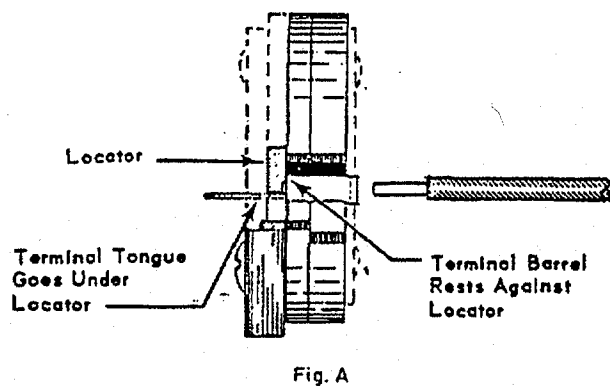
<u>Wire Sizes</u>	<u>Color</u>
26-22	Yellow
22-16	Red
16-14	Blue
12-10	Yellow
8	Red
6	Blue
4	Yellow
2	Red
1 0	Blue
2 0	Yellow
3 0	Red
4 0	Blue

The locator (stop plate) on some crimpers is used to position the different types of connectors (e.g., ring tongue on butt-connectors) and is to be used to position the connectors In all cases. Refer to figures A and B.

The majority of crimping tools use a ratchet control that prevents the opening of the jaws once the crimp is begun. This is to insure that the correct amount of pressure is applied to the connector.

Maintenance should consist of lightly lubricating all pins and pivot points as necessary. Use IBM No. 9 oil, P/N 3034653.

\*Adjustment pins available P/N 3144921



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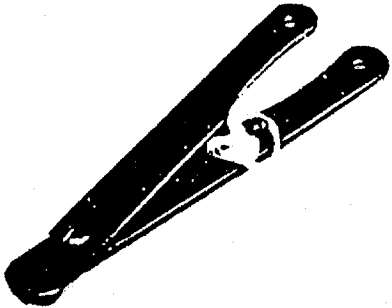
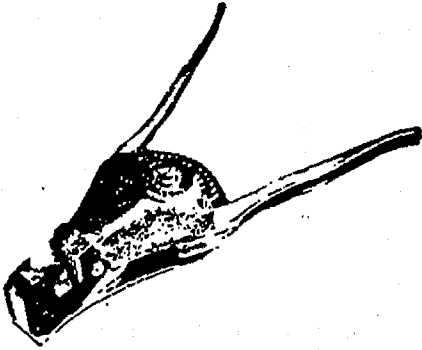
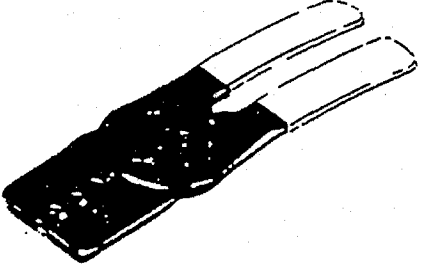
	<p><b>5 INCH STRIPPER</b></p> <p>P/N 3287825 General usage when working space is limited</p>
	<p><b>WIRE STRIPPER (SEMI-AUTOMATIC)</b></p> <p>P/N 3034843 Wire Sizes #8 - #22</p>
	<p><b>COAXIAL STRIPPER</b></p> <p>P/N 3033866 Used on coaxial cables</p>

FIGURE 3-1. WIRE STRIPPERS


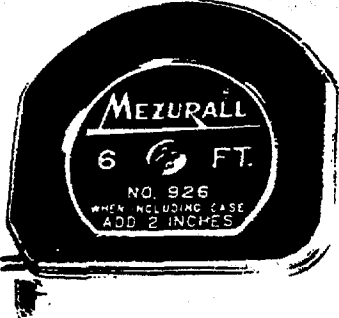
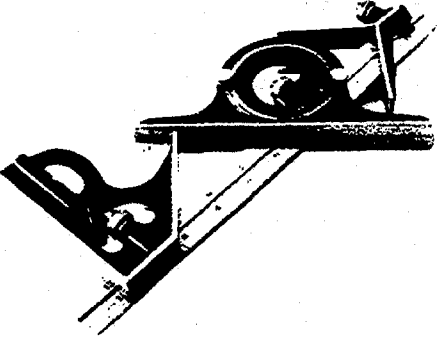
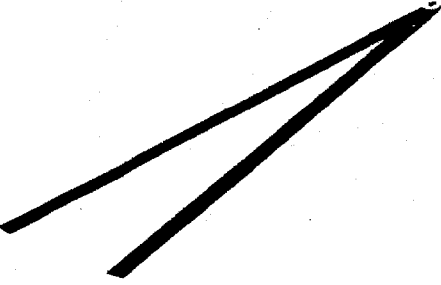
	<p><b>RULES</b></p> <p>P/N 3287745 - 6 in. P/N 3287746 - 12 in.</p>
	<p><b>RULES</b></p> <p>P/N 3287795 - 6 ft. tape</p>
	<p><b>COMBINATION SQUARE (12")</b></p> <p>P/N 3287765</p>
	<p><b>THICKNESS GAUGE</b></p> <p>P/N 3033417 - 0.015 - 0.020 in.</p>

FIGURE 3-2. MEASURING TOOLS

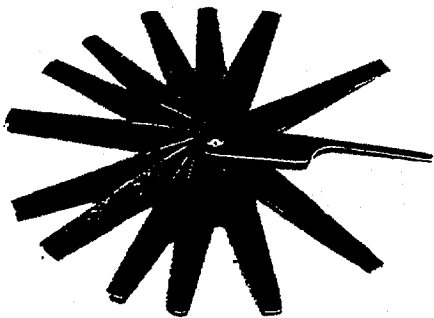
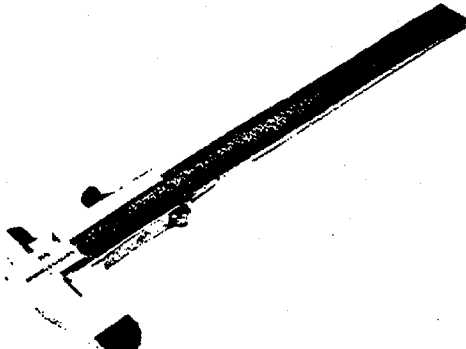
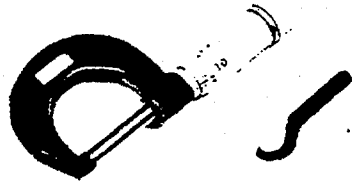
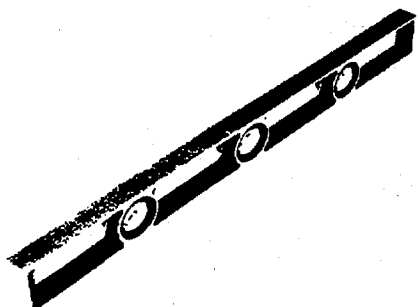
	<p>THICKNESS GAUGE</p> <p>P/N 3033365 - 0.001 - 0.030 INCH  P/N 3134955 - 0.00015 INCH</p> <p>Used for polar relay adjustment</p>
	<p>VERNIER CALIPER</p> <p>P/N 3034832</p>
	<p>MICROMETER (0 - 1")</p> <p>P/N 3287609</p>
	<p>LEVEL (24")</p> <p>P/N 3287726</p>

FIGURE 3-2. MEASURING TOOLS (con't)

Table 16 in the Appendix illustrates the crimping tools available and lists all pertinent data pertaining to their usage.

### 3.4 MEASURING TOOLS

The tools described in this section are illustrated in figure 3-2.

#### 3.4.1 Rules

The 6-inch and 12-inch steel machinist rules and the 6-foot steel tape are used primarily in measuring and in layout work. They are graduated in  $1/8$ ,  $1/16$ ,  $1/32$ ,  $1/64$  inch. When using the rule, the scale with the largest fraction required should be used. This reduces the possibility of reading the scale incorrectly. A ruler can be used for most measurements over .01 inches, however, when a precision measurement is desired, the micrometer or vernier caliper should be used. When the rule is to be returned to stock, be sure that it is clean and dry. A damp rule will rust easily and have to be replaced.

#### 3.4.2 Combination Square

This tool is designed to be used in the measurement, layout, and checking of angles. It consists of a 12-inch rule and three different heads. The square stock head is used as a regular square for 90-degree angles or as a square for 45-degree angles. It also has a built-in spirit level which may be used for leveling horizontal surfaces and plumbing vertical surfaces. The protractor head is used to measure any angle with respect to the rule. It contains a circular scale marked off in degrees and can be locked at the desired angle. The third head, called a center head, is used to mark the center of round objects. It is designed so that each of the extensions is 45 degrees from the edge of the rule. By placing the round object between the two extensions, the edge of the rule will bisect the exact center of the work. The square is then moved approximately 90 degrees from the original position and another center line is scribed. Where the two lines bisect, is the center point of the round object being measured.

#### 3.4.3 Thickness Gauge

This tool, commonly called a feeler gauge, is used to measure the space between two objects. It is used primarily for setting the gap of relay and cam contacts. Each blade of the gauge is marked with its thickness. Blades are available in sizes from .001 inch to .030 inch. The smaller of these blades are very thin; they should be handled with care because they bend and kink easily.

When using the thickness gauge, the blade should just slide into or out of the gap. It should not move too freely or be too tight. The best method to use for precision adjustments is to try to insert the next larger blade into the gap. If the correct size blade fits and the next larger blade does not, the adjustment is correct.

#### 3.4.4 Vernier Caliper

This tool is a precision measuring device used to measure both inside and outside dimensions. It can be read accurately down to one thousandth (.001) of an inch. The caliper is composed of two parts. One part is a fixed scale graduated into .025 inches, and the other part is a movable section containing a vernier scale which has 25 divisions of .024 inches each numbered every fifth division. The difference between a division on the vernier and a division on the fixed scale is .025 inch minus .024 inch, or .001 inch.

To read the measurement, note the number of inches, to the nearest .025 inch, that are between zero on the vernier and zero on the fixed scale. Consider only the last division to the left of zero on the vernier scale. Then note the number of divisions on the vernier scale from its zero mark to the mark that exactly coincides with a mark on the fixed scale. For example, in figure 3-3, the reading on the fixed scale indicates that the vernier is two and five tenths and .025 inches from zero on the fixed scale. This value is read as 2.525. Observing the vernier scale, it can be seen that the fifteenth line on the vernier coincides with a line on the fixed scale. Notice that no other two lines exactly coincide. This figure is read as .015 inch. By adding the two numbers together, the actual distance is obtained. In this example this figure would be  $2.525 + .015 = 2.540$  inches.

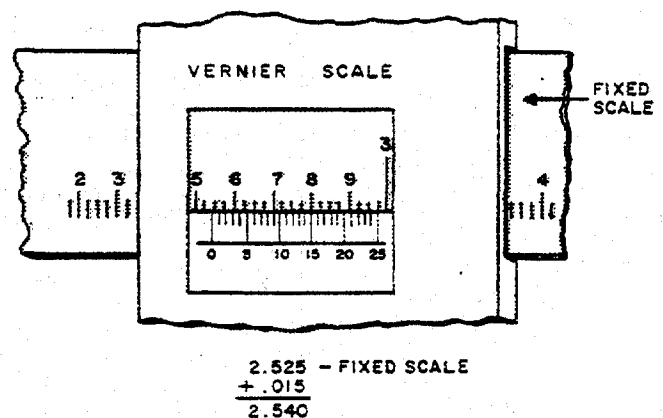


FIGURE 3-3. READING THE VERNIER CALIPER

The same scale may be used to read both inside and outside dimensions. To obtain an accurate dimension the large outside or small inside jaws must be brought to bear in a plane perpendicular to the work to be measured.

### 3.4.5 Micrometer

The micrometer is the most commonly used precision measuring device. The micrometer now in use at field locations is used to obtain very accurate external dimensions in graduations of .001 inch, with a maximum limit of one inch.

The standard micrometer contains five principle parts: frame, anvil, spindle, thimble, and sleeve (fig. 3-4). The spindle is threaded through the sleeve and fastened to the thimble. The spindle has 40 threads per inch, which means that one revolution of the spindle will equal  $1/40$  or .025 inch. A scale containing 25 spaces is marked on the thimble with each space equal to .001 inch. The sleeve scale is marked off in .025-inch divisions, and one revolution of the thimble moves the spindle the distance of one space on the sleeve scale. The number etched on the sleeve scale indicates a division of 1.10 inch.

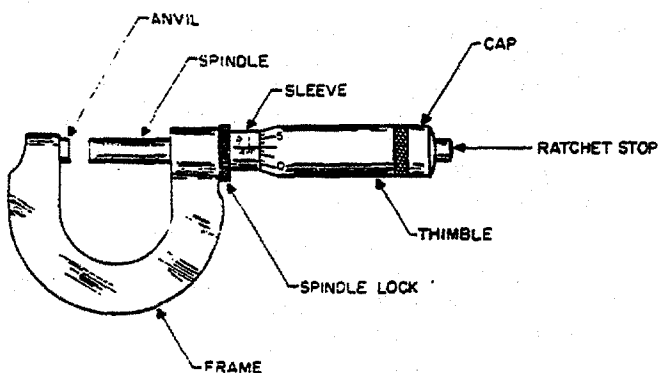


FIGURE 3-4. MICROMETER TERMINOLOGY

A revolution line is cut lengthwise on the sleeve and, in conjunction with the zero line on the thimble, counts the revolutions of the spindle. When the end of the thimble matches any of the cross lines on the sleeve and the zero line matches with the revolution line, the number of spaces exposed on the sleeve denote the number of spindle revolutions and consequently the number of .025-inch divisions. In figure 3-5, the readings on the three micrometers are .215, .370, and .326, respectively. In the first example (.215) it can be seen that the reading on the sleeve is .200 and the reading on the thimble is .015. In the second example the readings are .350 and .020, on the third .325 and .001. To simplify the reading of the micrometer, the numbers on the sleeve should be read as hundredths and the

numbers on the thimble as thousandths. Often the revolution line on the sleeve does not line up exactly with a line on the thimble. When this occurs, the next highest number on the thimble can be used or the actual position can be estimated in ten thousandths.

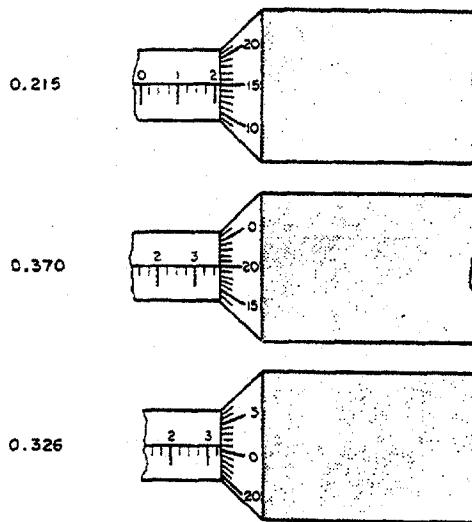


FIGURE 3-5. READING THE MICROMETER

Micrometers are equipped with a lock nut and a ratchet stop. The lock nut is used to lock the spindle to insure an accurate reading, and the ratchet stop will cause the spindle to stop its forward movement when it touches the item being measured. This prevents the user from applying excessive pressure to the spindle, and damaging the micrometer.

After the micrometer has been in use for a period of time it can possibly be out of adjustment. This is indicated when the end of the spindle touches the anvil but the zero on the thimble is not aligned with the revolution line. The following procedure outlines the method of adjusting the micrometer.

- Loosen the cap which locks the spindle and thimble together, using the small spanner wrench supplied.
- Grip the spindle and turn the thimble  $1/4$  turn counterclockwise.
- Release the spindle and bring the contact face of the spindle and the anvil face together.
- Turn the thimble clockwise until the zero line matches the revolution line on the sleeve.
- Move the spindle away from the anvil by



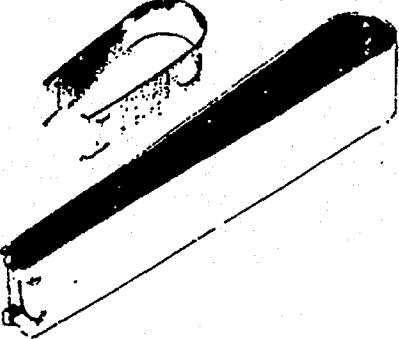

	<p>SCREW EXTRACTOR</p> <p>Refer to Table 6 in the appendix for part number and sizes.</p>
	<p>TUBE PULLERS</p> <p>P/N 3033493</p>
	<p>RELAY PULLERS</p> <p>P/N 3033356 (Latch Type Relay) P/N 3204407 (Latch Type Relay)</p>
	<p>LAMP EXTRACTOR</p> <p>P/N 3034132</p>

FIGURE 3-6. EXTRACTING TOOLS

turning the spindle and not turning the thimble.

- f. Hold the thimble securely and replace the cap.
- g. Lock the cap with the spanner wrench supplied.

#### 3.4.5A. Using The Micrometer

Prior to using a micrometer, check the calibration date to ensure the micrometer is not overdue calibration. Both the date calibrated and the date due will be read with the year first, then the Julian date. If the date due has already passed, return it to the tool crib and obtain a currently calibrated micrometer. It is advisable at this point to inspect the micrometer for missing or broken parts. This ensures the reliability of the micrometer. Once the micrometer is in working condition, it is ready for measuring. The following procedures outline the method for using the micrometer:

- a. Unlock the spindle lock by turning it counter-clockwise.
- b. Adjust the thimble so the space between the spindle and anvil is wider than the hardware to be measured.
- c. Place the hardware between the spindle and anvil.
- d. Turn the thimble clockwise until the spindle and anvil lightly touch the hardware.
- e. Turn the ratchet stop clockwise until one click is heard. This prevents the user from

applying too much pressure to the spindle, and damaging the micrometer.

- f. Turn the spindle clockwise to lock. This will help to ensure an accurate reading by preventing movement at the spindle.

#### 3.4.5B. Reading The Micrometer

(Refer to Figure 3-5, Drawing 2)

Once you have an accurate measurement, you must now understand how to read the scale to determine the proper measurement. The following steps outline the instructions for reading a micrometer.

- a. Read the highest figure visible on the sleeve.  
3 = 0.300 in.
- b. Count the number of lines visible between the No. 3 and the thimble edge. 2 = 0.050 in.
- c. Read the line on the thimble scale that coincides with or has passed the long line on the sleeve scale. 20 = 0.020 in. TOTAL = .370 in.

\* To properly read the decimals see TO 32-1-151, page 89, para 28.b, decimals.

#### 3.4.5C. Storing The Micrometer

After you have finished using the micrometer, the spindle lock should be unlocked by turning counter-clockwise and an air gap placed between the anvil and spindle. Both will prevent undue stress while in storage. Then place the micrometer in the case along with the spanner wrench and secure.

### 3.4.5.1 Care of Micrometers

The following rules should be observed in handling micrometers:

- a. Never use a micrometer with a dirty anvil and/or threads. Dirt on the anvil results in incorrect readings. Dirty threads cause excessive wear.
- b. Do not carry the micrometer in clothing pockets since dirt and dust from the pockets will work into the threads.
- c. After each use, wipe the anvil and spindle clean with a soft cloth.
- d. When not in use, place the micrometer in the case supplied.
- e. Always maintain a firm grip on the micrometer. Never hold it in such a manner that it would possibly be dropped or hit against another object.
- f. Remember that a micrometer is a delicate instrument and treat it as such.

These statements, while being directed towards the care of micrometers, also apply to vernier calipers or any precision measuring device.

### 3.5 SCREW EXTRACTOR

This tool, illustrated in figure 3-6, is used to remove screws or bolts that are broken in such a manner that neither a screw driver or a wrench can be used to remove them. Prior to using this tool, a hole slightly smaller than the minor thread diameter is drilled into the broken screw. The proper size extractor (five different sizes are available) is then inserted into the hole and rotated counter-clockwise using a wrench. Since the threads on the screw extractor are reversed, the rotation of this tool will cause the broken screw to rotate counter-clockwise, extracting it from the hole.

### 3.6 RELAY PULLER

When inserting or removing wire contact relays, the relay puller (fig. 3-6) should be used. If the relay is removed without using this tool, it is possible to snap off the guide pin or to damage the contact pins. Often relays are located in such a position that the only way they can be grasped is with a relay puller.

When using this tool, the four extensions should fit behind the relay yoke with the two flat plates outside the yoke assembly. The force applied should be in a straight line. To avoid damage to the contact pins the relay should never be rocked to loosen it from the plug.

### 3.7 TUBE PULLERS

Rubber tube pullers (fig. 3-6) should always be used to remove tubes from pluggable units or sub-assemblies. This tool serves two distinct functions. One is to provide a good grip on the glass tube envelope, and the other is to protect the user's hands from the heat generated by the tube.

### 3.8 LAMP INSERT - EXTRACT TOOL

This tool (fig. 3-6) is similar to the tube puller in both appearance and use. It is used to aid in the removal or insertion of 48-volt indicating lamps.

### 3.9 PLUGGABLE UNIT, TUBE, AND RELAY EXTENSIONS

To check for certain malfunctions, it is often necessary to examine the unit while in its operating condition. To do this, the unit being checked must be extended so that measurement within the unit can be obtained. This is accomplished by using the extenders illustrated in figure 3-7.

When using the extension, remove power prior to inserting it in the vacated location. The extensions supplied for pluggable units have a locking device to hold the extender in the pluggable unit socket. Be sure that the extender is locked in position before inserting the pluggable unit.

A test extension for wire contact relays is also supplied. One end of this insulated tool is inserted into the relay receptacle and the other end connected to the desired test equipment. Its primary function is to provide easy access to the relay receptacle terminals for voltage and signal measurements.

### 3.10 LUBRICATING TOOLS

These tools are illustrated in figure 3-8.



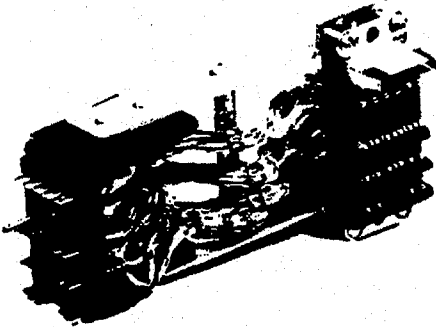

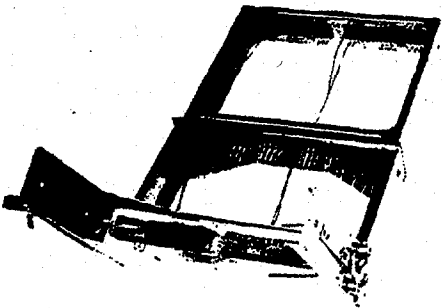
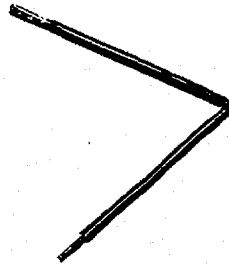
	<p><b>RELAY EXTENSIONS</b></p> <p>P/N 3033350 (4 pt.)  P/N 3033352 (6 pt.)  P/N 3033351 (12 pt.)</p>
	<p><b>TUBE SOCKET ADAPTERS</b></p> <p>P/N 3034147 - 7 pin miniature  P/N 3034148 - 8 pin octal  P/N 3034149 - 9 pin miniature</p>
	<p><b>P. U. EXTENSIONS</b></p> <p>P/N 3033442 - Core Driver Array  P/N 3033447 - Tube 9  P/N 3033448 - Tube 6  P/N 3033379 - Tape Drive P. U. 's</p>
	<p><b>RELAY TEST EXTENSION</b></p> <p>P/N 3033353</p>

FIGURE 3-7. EXTENSIONS

### 3.10.1 Oil Mist Lubricator

This tool is used to lubricate drum bearings as a preventive maintenance measure. When operated, the lubricator sprays a fine mist of oil over the affected parts. The lubricant used is IBM #6, P/N 3034652. The oil reservoir should be filled to just below the scribed line.

Oil misting is carried out in the following manner:

- a. Remove both thermometers from the drum rotor shaft. On the non-pulley end, it is necessary to remove the photomultiplier tube before the thermometer can be removed.
- b. Swab out both ends of shaft with IBM #6 oil, P/N 3034652. It is very important that the shaft be clear of all foreign matter before the oil mist lubricator is attached to the drum. Use 6-inch cotton applicator, P/N 3034801.
- c. Remove the dust caps, P/N 3204895, from the oil mist lubricator hose lines.
- d. Attach the hose line connectors to both ends of the shaft. Check to see that the hose is free of kinks and sharp bends.
- e. Plug the ac power line for the lubricator into a 115V convenience outlet.
- f. Turn on the lubricator and allow it to operate.
- g. After ten minutes of operation, turn off the lubricator and remove the hose line connectors.
- h. Replace the hose line covers to prevent entry of foreign matter into the hose lines.
- i. Replace both thermometers and the photomultiplier tube.

### 3.10.2 Oil Ramrod

The oil channel which oils the drum bearing is extremely small. Oil dropped into this channel will not reach the bearings. The purpose of the oil ramrod, therefore, is to force the oil down into the area of the drum bearing. After the oil is inserted into the channel, the ramrod is placed into the hole and pushed. This forces the oil into the bearing.

### 3.10.3 Lubrication Atomizer

Whenever a fine film of oil is required, such as on card machine gearing, this tool should be used. By compressing the rubber ball on the atomizer, a fine spray of oil is ejected.

### 3.10.4 Lubricating Gun

This tool is used mainly on card machines and other gear driven units requiring the use of a heavy grade grease such as IBM #20, P/N 3034664, DC-44, P/N 3034736, etc. Extensions are supplied for use with this tool when the grease fitting is difficult to reach using the standard gun.

### 3.10.5 Other Lubricating Tools

Four other oil applicators are supplied at the sites; the oil syringe, 2 oil pumps, and oil can. All four of these tools can be used for lubricating purposes and the one to be used will depend upon the type of work being performed. The oil pump is very useful when refilling the oil reservoirs of the card machines.

## 3.11 PROBES AND ALIGNMENT TOOLS

Occasionally it is necessary to make adjustments that are very critical. The use of a standard screwdriver, in this case, will cause incorrect readings due to the magnetic effect of the metal blade. When this situation occurs, the insulated probes designed for this purpose should be used. The probes available are illustrated in figure 3-9..

A voltage detection probe is also supplied for use in relay coil circuits. This tool checks for the presence of -48VDC or ground. It contains two neons that will indicate which, if either, of the two signals is present. The red lead of the unit should be connected to -48VDC, the black to ground, and the probe point to the circuit point under test.

## 3.12 PUNCH AND ANVIL ASSEMBLY

This tool is used when working on Units 28 or 91. It is used when inserting the panel jacks part number 3108050 and 3003668. The performance of this job requires two men: one man holds the anvil behind the panel, and the other man, using the punch, inserts the new jack.

## 3.13 DRUM HEAD ADJUSTMENT TOOL

The drum head adjustment tool, part number 3135039, is designed to be used with the handle in screwdriver kit, part number 3287747. It is a double ended insert with a 3/32" hex bit and a 5/64 hex bit. The 3/32" hex bit is used when adjusting the latest style aluminum head, while the 5/64" bit is used to adjust the early style aluminum heads. When removing the adjustment tool from a screw always pull the tool straight out. If the tool is removed at an angle, it will bind and could possibly result in the insert being pulled out from the handle.


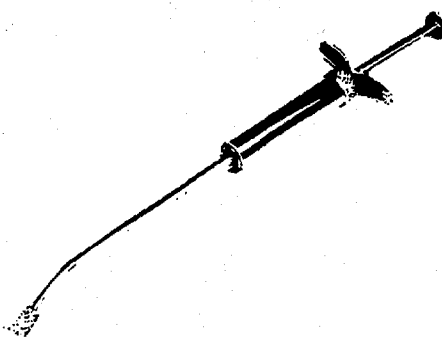
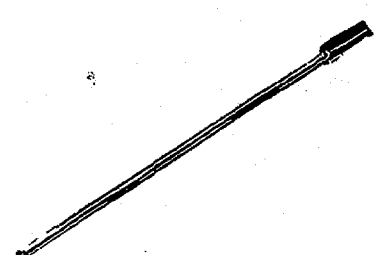
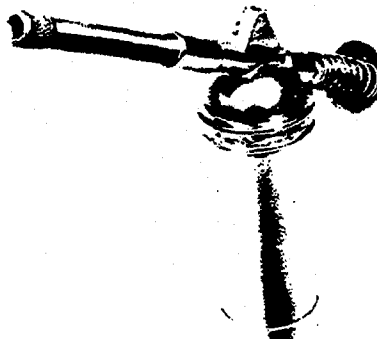
	<p>LUBRICATION ATOMIZER</p> <p>P/N 3287829 - Force Feed, 6 oz.</p>
	<p>OIL SYRINGE</p> <p>P/N 3033386</p>
	<p>OILER EXTENSIONS</p> <p>P/N 3033381</p> <p>Used with oiler P/N 3033386</p>
	<p>GREASE GUN</p> <p>P/N 3287719</p>

FIGURE 3-8. LUBRICATION TOOLS

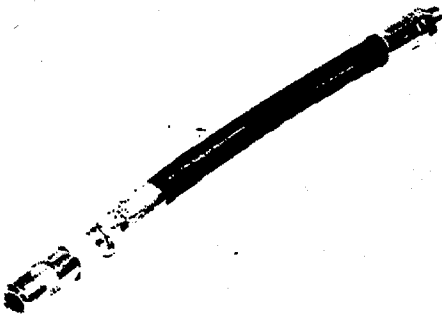
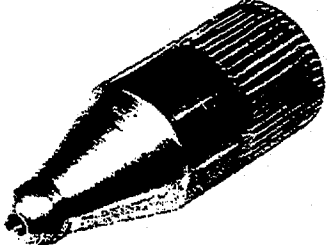
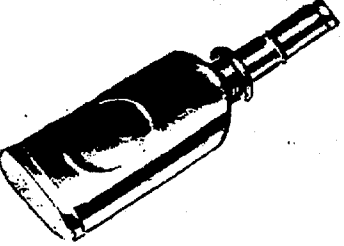
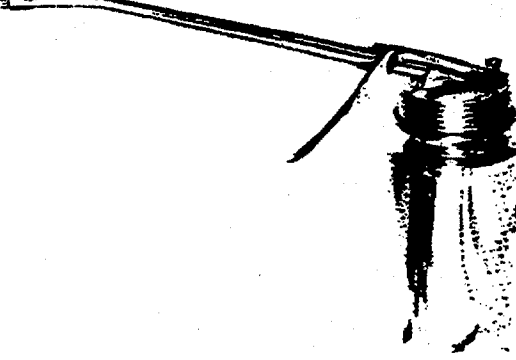
	<p>GREASE GUN ADAPTER</p> <p>P/N 3204369</p>
	<p>GREASE GUN ADAPTER</p> <p>P/N 3204388</p>
	<p>OILER</p> <p>P/N 3287828</p>
	<p>OILER PUMP</p> <p>P/N 3287729</p>

FIGURE 3-8. LUBRICATION TOOLS (cont'd)

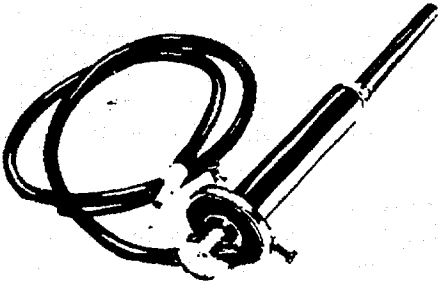

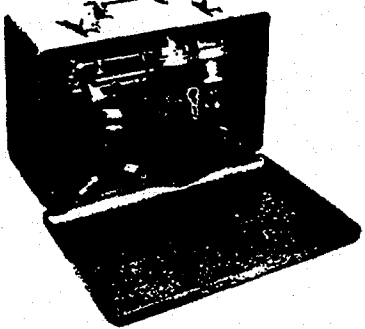

	<p>OIL PUMP</p> <p>P/N 3033494</p>
	<p>OIL RAMROD</p> <p>P/N 3204284</p>
	<p>OIL MIST LUBRICATOR</p> <p>P/N 3204890</p>
	<p>GREASE GUN</p> <p>P/N 3142451</p> <p>P/N 3142452 - 3-ft. hose</p> <p>P/N 3142453 - hose attachment</p> <p>P/N 3142454 - pin type fitting</p>

FIGURE 3-8. LUBRICATION TOOLS (cont'd)

### 3.14 BENCH GRINDERS AND OILSTONES

The bench grinder (fig. 3-9) is used to sharpen tools, dress screwdrivers, and to shape and smooth metal stock. Avoid grinding of non-ferrous metals (brass, copper, aluminum, etc.) on the grinder supplied; special grinding wheels are required for this purpose.

The bench grinder available at the sites is equipped with two different types of grinding wheels. One wheel is coarse and is used for rough grinding, the other is fine and is used for tool sharpening and finish grinding. These grinders are also equipped with safety shields and tool rests. The tool rest should be adjusted so that the space between the grinding wheel and the tool rest is approximately 1/16 inch, but never over 1/8 inch.

Flexstones and oilstones (fig. 3-9) can also be used for removing burrs and rough edges. A further use of the oilstone is the sharpening of tools. Flexstones are not to be used for this purpose.

#### 3.14.1 Mounting Grinding Wheels on Spindles

The following procedure should be used when grinding wheels are to be mounted on the spindle.

- a. Inspect the wheel for flaws and make the "ring test"
- b. Clean the bearing surfaces of wheel, flanges and spindle so that the clamping pressure will be evenly distributed.
- c. Check the speed of the spindle to make sure that it is not running too fast for the type and size of wheel.
- d. Make sure that the hole in the wheel bushing is the right size for the spindle. (neither too small nor too large).
- e. Use flanges that are recessed and large enough to clamp the wheel well toward its circumference.
- f. Tighten the spindle end nuts just enough to keep the wheel from moving out of position between the flanges.
- g. Before turning on power, make sure that the wheel runs true and will strike no obstruction.

#### 3.14.2 Grinding Wheel "Ring" Test

New grinding wheels should be unpacked promptly upon receipt and should be given the "ring" test for damage suffered

Give this test also immediately before mounting either a new or used wheel on the spindle, especially if the wheel has been in storage for a considerable time.

Most defects in grinding wheels, including flaws and cracks, are not visible to the naked eye, but the "ring" test readily discloses them.

Make the test by suspending the wheel free and clear and tapping it gently with a light wooden implement, such as a wooden screw driver handle for light wheels, and a wooden mallet for heavy wheels.

Sound and undamaged wheels will give for the clear metallic tone when tapped. If defective there will be no ring.

Wheels bonded with organic material do not give forth the same clear metallic sound as do verified and silicate wheels.

Any wheel should be dry and free of sawdust when the "ring" test is given; otherwise the sound will be deadened.

#### 3.14.3 Grinding Suggestions

Listed below are several suggestions that, if followed, will eliminate machine abuse and provide maximum protection for the operator:

- a. Wear safety glasses at all times when working near the grinder, including the period of adjusting guards and tool rest. Do not remove the glasses until the job is completed and the machine shut off.
- b. Be sure that the wheel guards, tool rests, and shields are properly positioned before applying power.
- c. Stand to the side of the grinder when turning it on. Allow the machine to run for one minute before engaging the wheel with the work. The turn-on period is the most likely time for a wheel to break.
- d. Keep the tool rest as close to the grinding wheel as possible (approximately 1/16 inch) when using the grinder; take small cuts with moderate pressure.
- e. Never use a glazed, worn, or uneven wheel; replace it.
- f. Never operate the grinder or attempt any repairs without having a thorough knowledge of the grinder's operation.

#### 3.14.4 Portable Rotary Polishers and Grinders

Portable rotary polishers and/or grinders are either electric or pneumatic powered types of various speed ranges. Wheels used on these tools vary from coarse grit for metal removal, fine grit for paint or rust removal, to soft fabric material for polishing surfaces.

When mounting wheels on spindles, the following procedures should be used:

- a. Inspect grinding wheels for flaws and make the "ring test" (Ref. para. 3.14.2).

- b. Clean the bearing surfaces of wheel, flanges and spindle so that clamping pressure will be evenly distributed.
- c. Make sure that the hole in the wheel bushing is the right size for the spindle (neither too small nor too large).
- d. Use flanges that are recessed and large enough to clamp the wheel well toward its circumference.
- e. Tighten spindle end nuts just enough to keep wheel from moving out of position between the flanges.

**WARNING**

Eye protection must always be used when operating these tools. A grinding wheel that has a glazed surface, or an uneven wheel should never be used.

**CAUTION**

- A hand held polisher or grinder must always be equipped with an operating switch that is either spring loaded or air pressure loaded to the cut-off position to cut-off power when the hand grip is released. Tools without this equipment should be discarded.
- Pencil type die grinders, designed with a rotary or a twist throttle control and not a spring or air pressure loaded cut off switch, may be used with cutting tools not greater than 1/8 inch diameter.

- Grinding wheels used must always be rated at a speed equal to or greater than the tool it will be used on.
- These tools should only be used on objects that are either massive enough or restrained to prevent grinding or polishing from moving or throwing the object. This tool shall never be used to grind or polish an item that is held by hand.
- These tools will never be equipped with a tool rest, on bench mounted grinders, but must always be equipped with a guard that will cover not less than one half the periphery of the wheel being used.

### 3.15 ADJUSTMENT OF PU HOLDING TOOL

The ball clutch should be tight at all times. It should be adjusted so that when it is tight the arm is no less than 1/2 inch from the end of travel. To adjust, loosen the setscrew and screw disc in base in or out as necessary. Tighten setscrew.

### 3.16 IMPACT WRENCHES

**WARNING**

Do not use common hand sockets with impact wrenches.

When using impact wrenches, care should be taken not to exceed the operating air pressure recommended by the manufacturer (120 psi). Assure that all sockets used are designed and manufactured for use as impact wrenches. Use manufacturer's recommendations for care and lubrication of all impact wrenches.





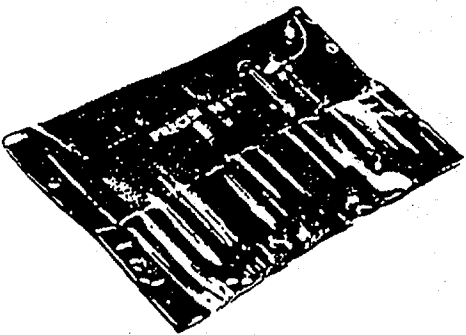
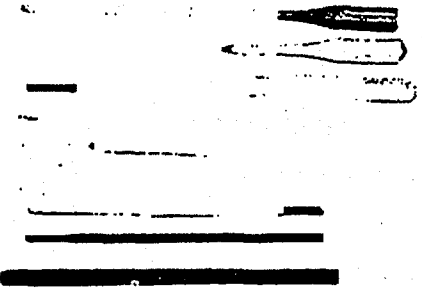
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	<p>VOLTAGE DETECTION PROBE</p> <p>P/N 3204139</p>
	<p>ADJUSTMENT TOOL KIT</p> <p>P/N 3287762</p> <p>All purpose adjustments Refer to Table 18 in the Appendix for part number and description of individual tools</p>
	<p>ALIGNMENT TOOL KIT</p> <p>P/N 3135040</p> <p>Used for aligning test equipment. Refer to Table 19 in the Appendix for part numbers and description</p>

FIGURE 3-9. MISCELLANEOUS SPECIAL TOOLS

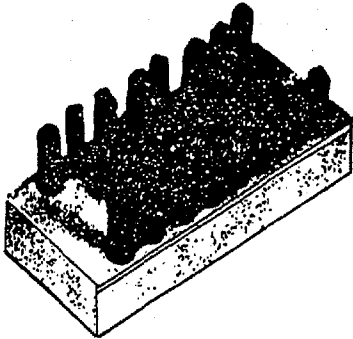
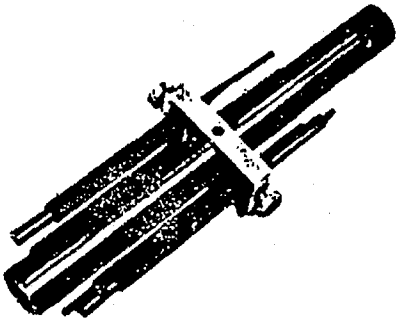

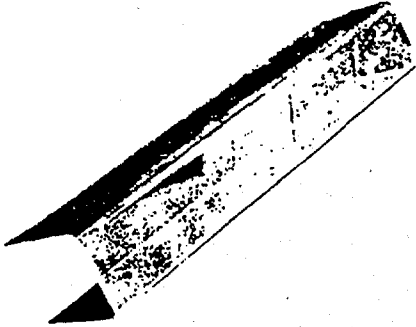
	<p>STAMP SET</p> <p>P/N 3204243 - 1/8 Inch Capitals  P/N 3204244 - 1/8 Inch Figures  P/N 3034978 - 1/16 Inch Capitals  and Figures</p>
	<p>PUNCH AND ANVIL ASSEMBLY</p> <p>P/N 3204165</p>
	<p>NIKE PIN TOOL</p> <p>P/N 3204373  Used to remove and install the split  retaining ring on Nike Connectors</p>
	<p>SAFETY SHIELD</p> <p>P/N 3204194  Used to cover capacitor trays while  they are being reformed</p>

FIGURE 3-9. MISCELLANEOUS SPECIAL TOOLS (cont'd)

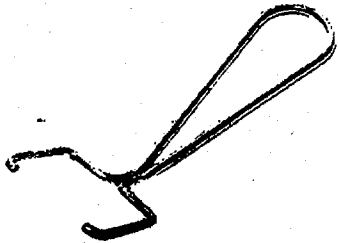
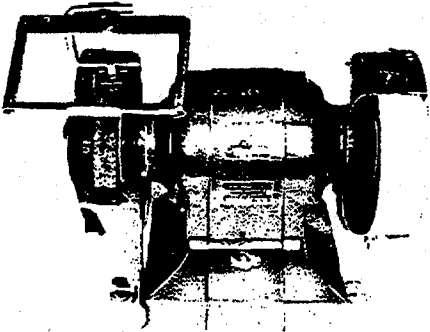
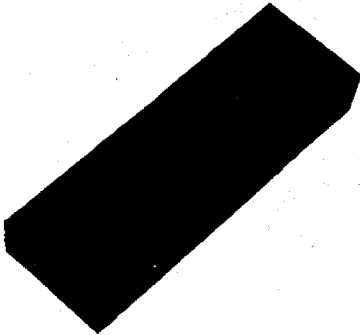
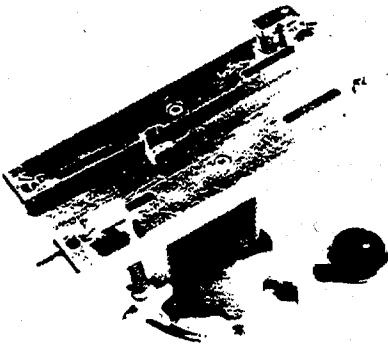
	<p><b>DRUM HEAD CONNECTOR EXTRACTOR</b></p> <p>P/N 3201367 (Instructions applicable to the use of this tool contained in M1-09)</p>
	<p><b>BENCH GRINDER</b></p> <p>P/N 3287605</p>
	<p><b>OIL STONES</b></p> <p>P/N 3287767 - Oilstone P/N 3287806 - Flexstone</p>
	<p><b>P. U. HOLDING TOOL</b></p> <p>P/N 3033440 Used to hold standard Pluggable Units while being repaired. This tool is mounted on a Work Bench in the Maintenance and Test Area.</p>

FIGURE 3-9. MISCELLANEOUS SPECIAL TOOLS (cont'd)

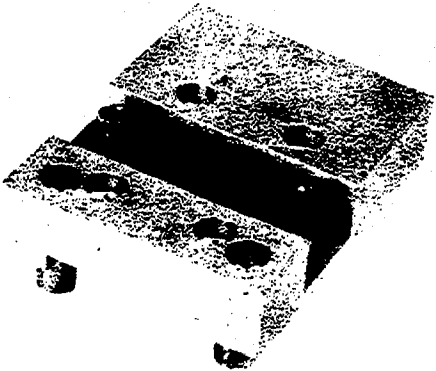
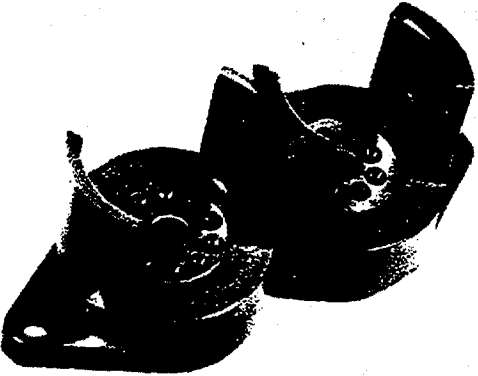
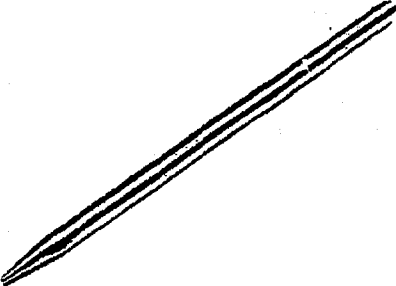
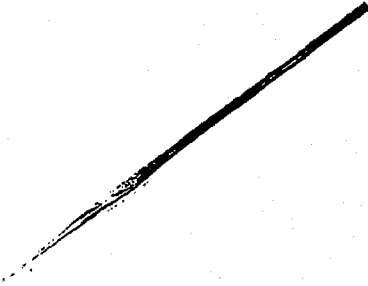
	<p><b>DIODE SWITCH CAN HOLDER</b></p> <p>P/N 3204389 Used to hold Diode Switch Cans while they are worked on.</p>
	<p><b>TUBE PIN STRAIGHTNER</b></p> <p>P/N 3287822 Used to straighten pins of 7 &amp; 9 pin miniature tubes.</p>
	<p><b>LEAD WINDER</b></p> <p>P/N 3034141 Wrapping a wire around this tool will provide a wire loop of the proper size for Core Plane Terminals.</p>
	<p><b>CROCHET NEEDLE #12</b></p> <p>P/N 3033496</p>

FIGURE 3-9. MISCELLANEOUS SPECIAL TOOLS (cont'd)

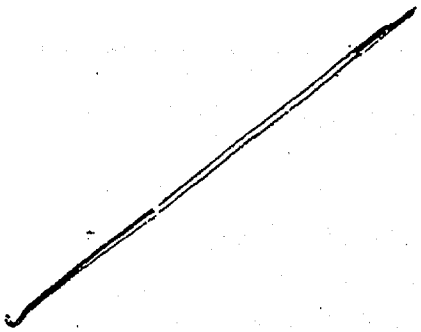


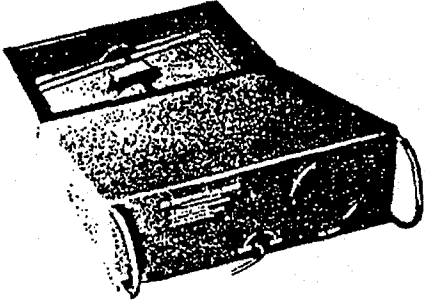
	<p><b>SPRING HOOK</b></p> <p>P/N 3033357 Used as an aid when inserting or removing small springs.</p>
	<p><b>MAGNIFIER MONOCULAR</b></p> <p>P/N 3287831 - (4X) Used for close inspection; Examples: QC inspection, checking for slipped cathodes, etc.</p>
	<p><b>RECTANGULAR READING GLASS</b></p> <p>P/N 3034823 Used for close inspection; Examples: QC inspection, checking for slipped cathodes, etc.</p>
	<p><b>AIR SHUT OFF UNIT</b></p> <p>P/N 3136463 - 9 tube P/N 3136472 - 6 tube</p> <p>Used to replace standard pluggable units when necessary to shut off air flow through module</p>

FIGURE 3-9. MISCELLANEOUS SPECIAL TOOLS (cont'd)


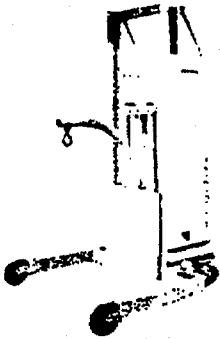
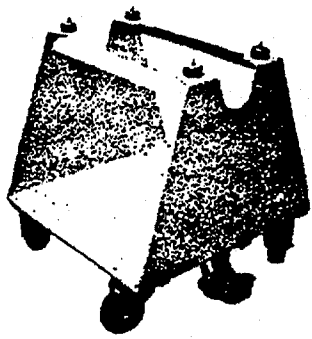
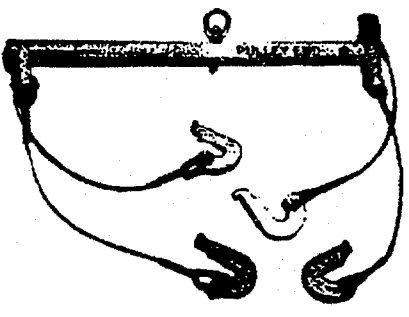
	<p>CAPACITOR DISCHARGE ASSEMBLY</p> <p>P/N 3200422 (72V - 600V)  P/N 3204482 (0V - 72V)  Used to discharge capacitor trays</p>
	<p>DRUM HOIST</p> <p>P/N 3204195  Instructions on the use of this tool  contained in M1-09</p>
	<p>DRUM DOLLY</p> <p>P/N 3204188  Instructions on the use of this  tool contained in M1-09</p>
	<p>DRUM LIFTING ASSEMBLY</p> <p>P/N 3204342  Instructions on the use of this  tool contained in M1-09</p>

FIGURE 3-9. MISCELLANEOUS SPECIAL TOOLS (cont'd)

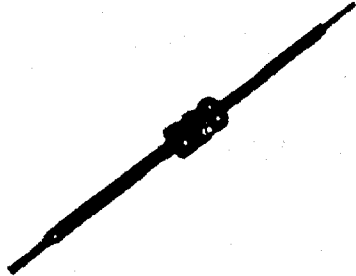
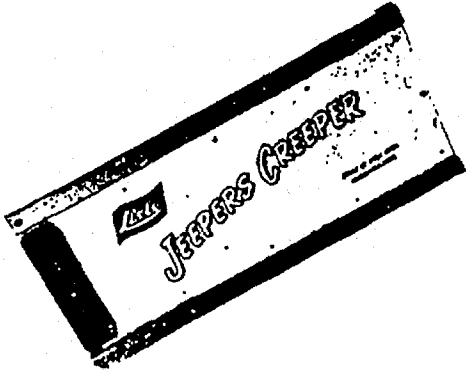
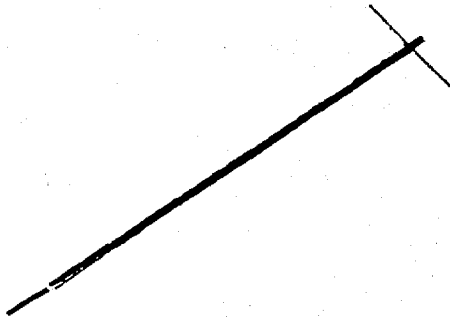
	<p>DRUM HEAD ADJUSTMENT TOOL</p> <p>P/N 3135039 Used to adjust heads on Main and Aux. Drums</p>
	<p>AUTOMOTIVE CREEPER</p> <p>P/N 3204348</p>
	<p>TEE WRENCH</p> <p>P/N 3204168 - 3/16 Inch Hex Used when removing Drum Pulley Guard (M1-09)</p>

FIGURE 3-9. MISCELLANEOUS SPECIAL TOOLS (cont'd)

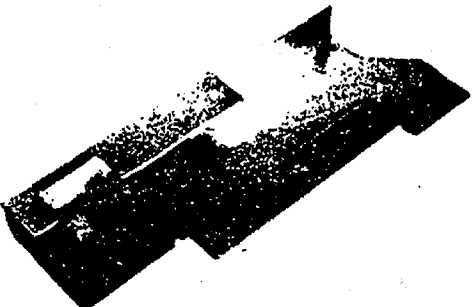

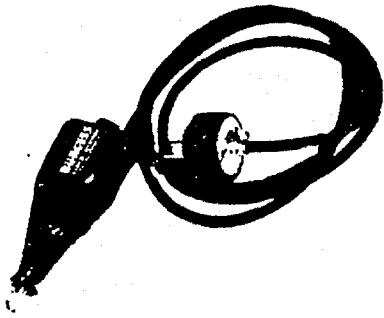
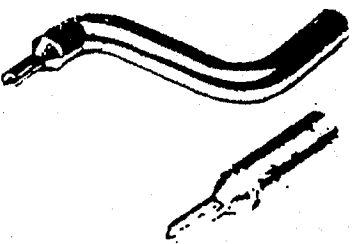
	<p>DRIVE BELT COVER</p> <p>P/N 3201368</p> <p>Used on the Automatic Pluggable Unit Tester 858 Card Reader Section</p>
	<p>CABLE LACING TOOL</p> <p>P/N 3204191</p>
	<p>VIBRO ENGRAVER</p> <p>P/N 3135033</p>
	<p>TIPS</p> <p>P/N 3135034 - Straight P/N 3204169 - Angle Used with Vibro Engraver</p>

FIGURE 3-9. MISCELLANEOUS SPECIAL TOOLS (cont'd)

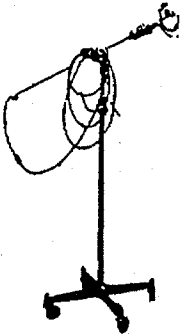
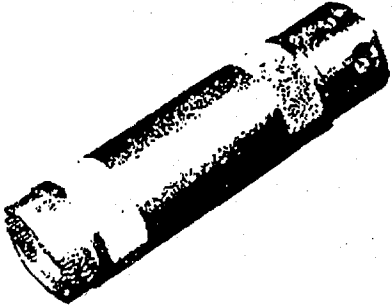
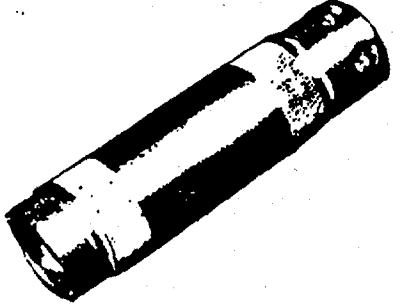
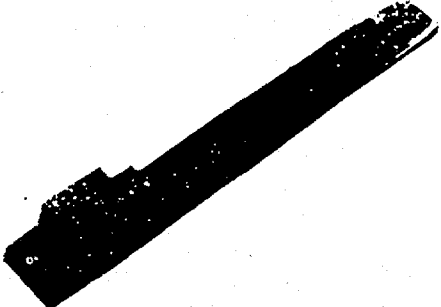
	<p>INFRA-RED LAMP ASSEMBLY</p> <p>P/N 3034798 - Stand Assembly --  P/N 3034799 - Boom Assembly and Lamp Guard  P/N 3034800 - Lamp</p>
	<p>5TH LENSE TOOL (PRRE)</p> <p>P/N 3204470  Instructions applicable to the use of this tool contained in M1-15</p>
	<p>6TH AND 7TH LENSE TOOL (PRRE)</p> <p>P/N 3204469  Instructions applicable to the use of tis tool contained in M1-15</p>
	<p>APERATURE ADJUSTMENT TOOL</p> <p>P/N 3204474  Instructions applicable to the use of this tool contained in M1-15</p>

FIGURE 3-9. MISCELLANEOUS SPECIAL TOOLS (cont'd)

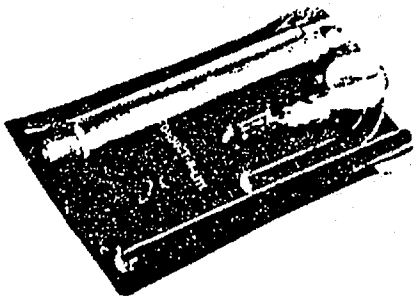
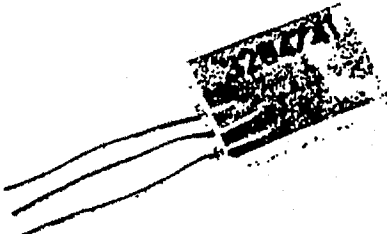

	<p><b>INSPECTION KIT</b></p> <p>P/N 3135075</p> <p>Used for quality control inspections</p>
	<p><b>TRANSISTOR ADAPTER</b></p> <p>P/N 3204741</p> <p>Used to test transistors (with cut leads) on Transistor tester P/N 3034682</p>
	<p><b>JIGGLE STICK</b></p> <p>P/N 3691401</p> <p>Used as a probe during quality control inspections</p>

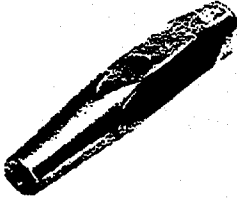
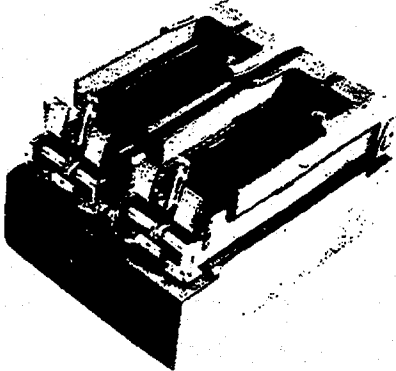
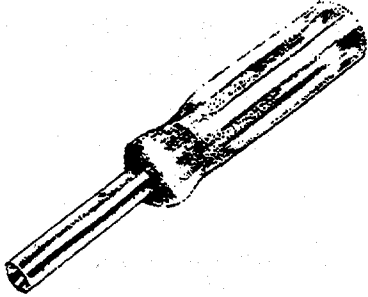
FIGURE 3-9. MISCELLANEOUS SPECIAL TOOLS (Cont'd)

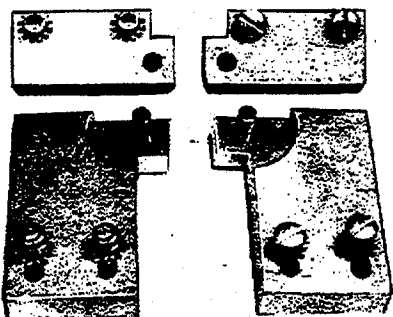
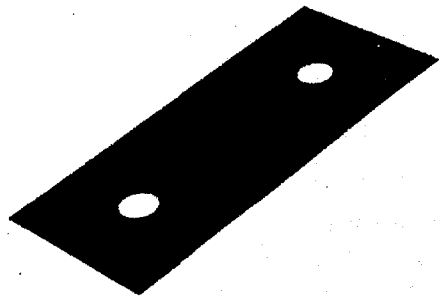
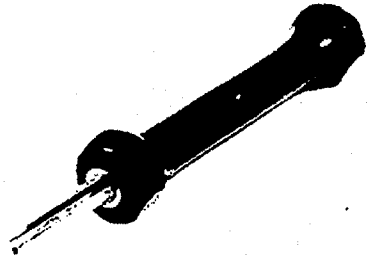
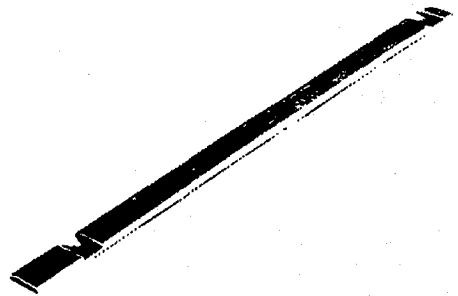
## Chapter IV

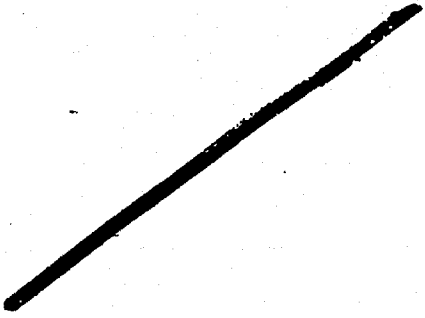
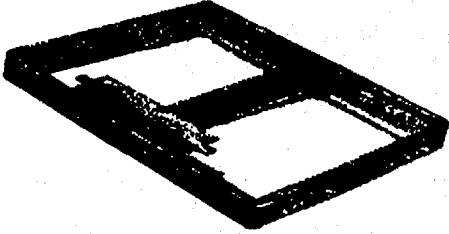
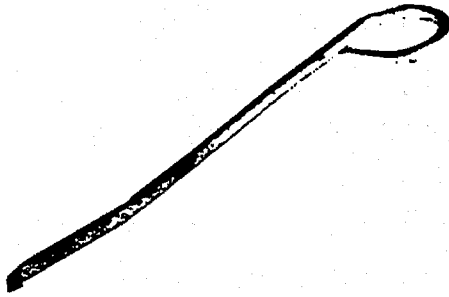
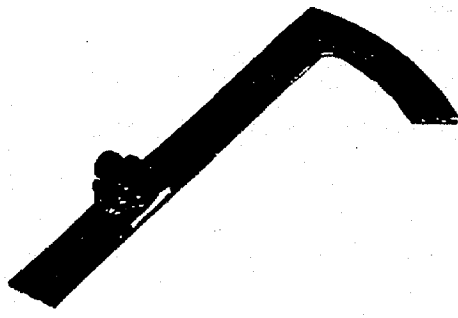
### AUXILIARY MACHINE TOOLS


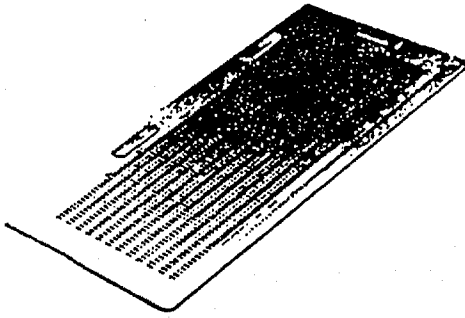
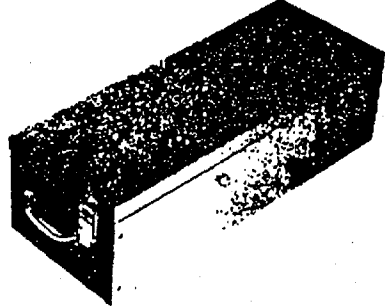
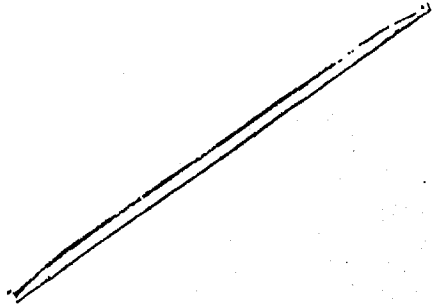
In this chapter, the tools used primarily on the auxiliary machine (Type 020, 713, 718, 723, and 729 machines) will be discussed. Since information relative to the use of these tools is contained in the DPM


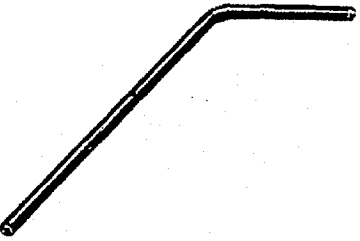
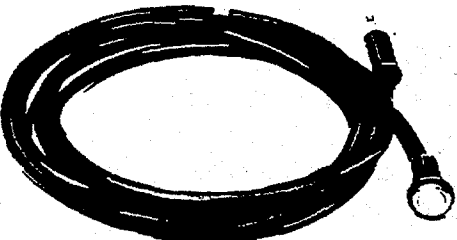
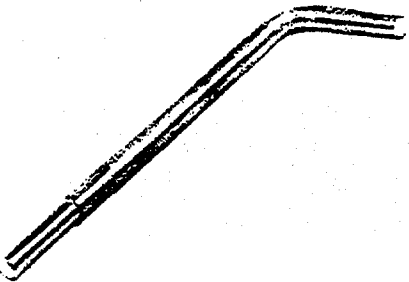
machine manuals and Maintenance Handbooks only a photograph of the tool and a brief description of its use will be included.

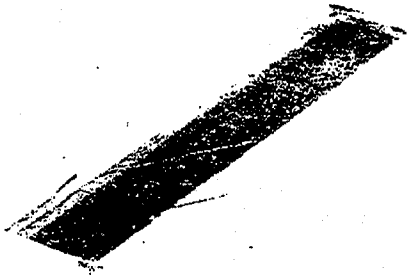
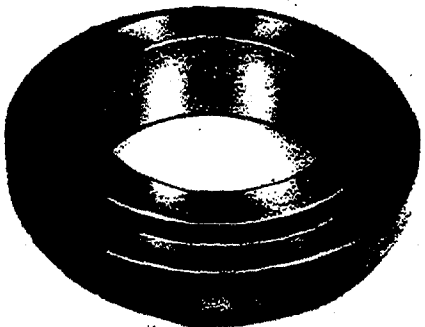
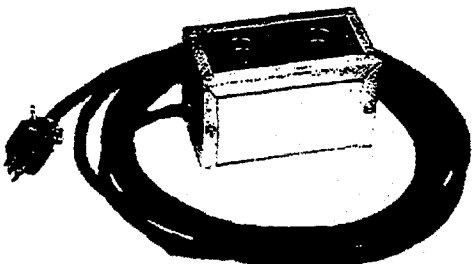

	<p><b>DOWEL PULLER</b></p> <p>P/N 3033355 (5-40 &amp; 10-32)</p> <p>Used to remove the dowel pins that connect card machine assemblies. By screwing this tool onto the dowel pin, the pin is removed. The operation of this tool is similar to a screw extractor.</p>
	<p><b>SIGNAL JUNCTION BOX-728</b></p> <p>P/N 3033375</p> <p>Used when it is desired to remove one tape drive from the serial signal line originating at unit 13.</p>
	<p><b>P. U. WRENCH - 728</b></p> <p>P/N 3033376</p> <p>Used to lock and unlock the tape drive pluggable units. Care should be exercised when using this tool to prevent damaging the screw blade.</p>

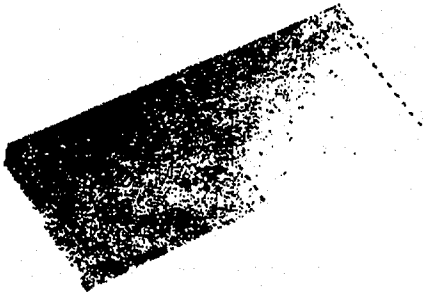

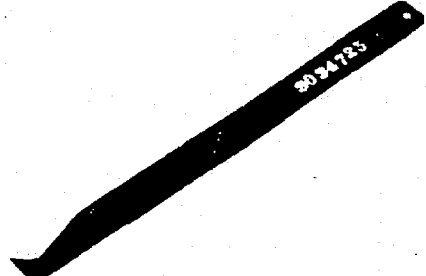
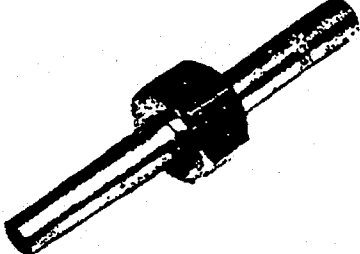
	<p><b>MAIN PLATE HINGE KIT - 728</b></p> <p>P/N 3033377 This tool is used on the Model 11 tape drive only. It is used when it is necessary to drop the tape drive main plate for access to the drive unit.</p>
	<p><b>CARD HOPPER GAUGE</b></p> <p>P/N 3135032 This tool, a metal plate the size of a standard IBM card, is used to adjust 723 feed knives for proper card buckle. The two holes in the gauge are for holding the tool when inserting it in the card hopper.</p>
	<p><b>CONTROL PANEL WIRING TOOL</b></p> <p>P/N 3033398 Used to insert and remove the permanent type plugboard wires.</p>
	<p><b>TYPE WHEEL ALIGNER</b></p> <p>P/N 3033410 This service tool is inserted between the 718 typewheels when the analyzer is being removed. This tool prevents the typewheels from turning and becoming misaligned.</p>

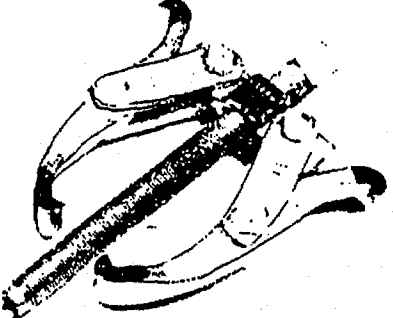
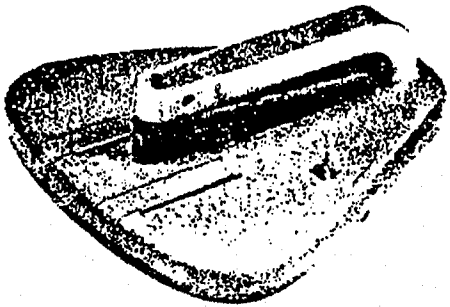

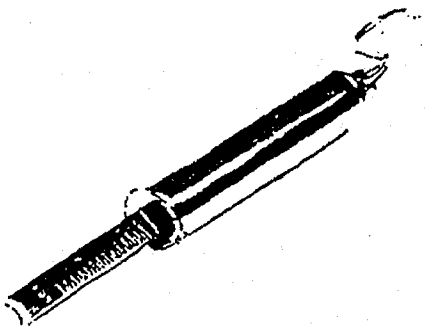
	<p><b>CLIP HOLDER &amp; PULLER</b></p> <p>P/N 3033411 Used to remove horseshoe type spring clips located in confined areas.</p>
	<p><b>CONTROL PANEL GAUGE</b></p> <p>P/N 3033414 - Single (display see-all console) P/N 3033412 - Double (card machines)</p>
	<p><b>BRUSH FORMING TOOL</b></p> <p>P/N 3033413 Used to relocate and form read brushes that are out of line.</p>
	<p><b>GRAM GAUGE</b></p> <p>P/N 3033415 - X2 Blade - P/N 3034824 This tool is used to measure various spring tensions and pressures. Two blades are supplied with the tool. The lighter blade is for direct scale reading, the heavier gives scale indications in multiples of ten.</p>

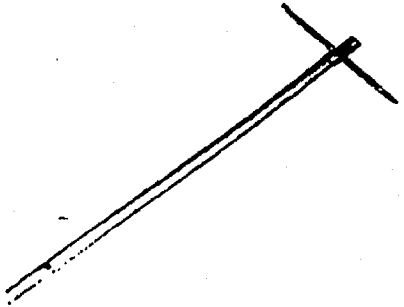
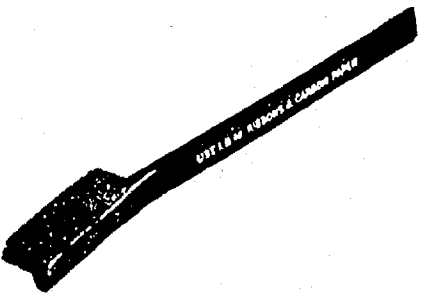
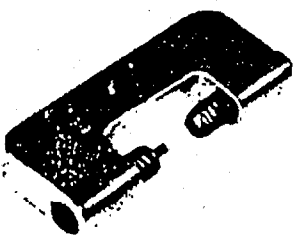
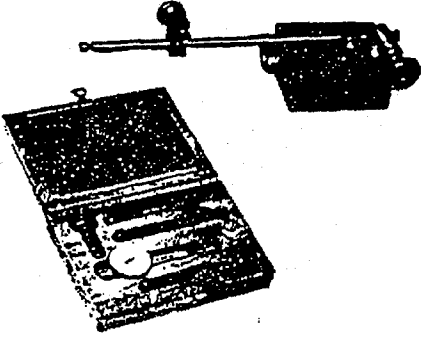
	<p>GO NO-GO GAUGE</p> <p>P/N 3136640 Used to check the card machine feed knives for correct measurements. This gauge is for .006-inch card stock</p>
	<p>CARD REGISTRATION GAUGE</p> <p>P/N 3033418 Used to check cards for proper registration. This is accomplished by comparing punched holes against a master plate. If holes are punched off center, card is out of registration.</p>
	<p>SHAFT AND SPINDLE BLOCK HOLDER ASSEMBLY-718</p> <p>P/N 3033419 The box is used to hold print cam shafts or selector gear shafts while the gears are being removed. The lid has three pegs used to hold the removed gears, keeping them in the correct sequence.</p>
	<p>SPRING CONTACT ADJUSTING TOOL</p> <p>P/N 3033420 Used to form contacts that are bent. It is particularly useful when re-forming wire contact relay receptacle pins.</p>

	<p><b>PRINT CAM AND SELECTOR GEAR ALIGNER</b></p> <p>P/N 3033421 This tool is used to keep the 718 print cams or selector gears in alignment while these units are worked on.</p>
	<p><b>CODE PLATE ALIGNING TOOL</b></p> <p>P/N 3033424 This tool is used when adjusting the 020 printing mechanism.</p>
	<p><b>PORTABLE START KEY</b></p> <p>P/N 3033426 Used as an extension of card machine start keys, enabling the technician to start the machine while working near the rear of the machine.</p>
	<p><b>120 DEGREE TIMING TOOL</b></p> <p>P/N 3033427 This tool is used in setting the 718 machine index in time with the mechanical units of the machine.</p>

	<p><b>BRUSH GAUGE</b></p> <p>P/N 3033428 Used when adjusting read brushes to the scribe line. The brush wires can be viewed through the plastic.</p>
	<p><b>REEL LATCH GAUGE</b></p> <p>P/N 3033431 Used to check the reel latch ring on both Model II and III Tape Drives.</p>
	<p><b>FORWARD - REVERSE BOX</b></p> <p>P/N 3033435 When plugged into the appropriate tape drive receptacle, this tool can be used to control the direction of tape movement.</p>
	<p><b>TAPE CLEANER GAUGE</b></p> <p>P/N 3033437 Used to check the tape cleaner blade adjustment. When correctly adjusted, this gauge will lie in a horizontal plane.</p>

	<p><b>READ BRUSH CALIBRATION GAUGE</b></p> <p>P/N 3034698 Check alignment of read brushes of the card-a-type feed (Auto P. U. Tester).</p>
	<p><b>CAPSTAN WRENCH - 728</b></p> <p>P/N 3034830 (5/16-inch box end) This special box wrench is used when replacing or removing a capstan drive motor.</p>
	<p><b>CARD JAM CLEARING TOOL</b></p> <p>P/N 3034725 Used to remove cards that jam in various machine locations. The serrated edge is used to cut the card. The hooked end is used to remove the pieces.</p>
	<p><b>KEY PUNCH SOCKET WRENCH</b></p> <p>P/N 3034764 Used when adjusting the star wheels on the 020 CEP. The proper size screwdriver P/N 3287750 is inserted into the shaft and used similarly to the drum head adjusting tool.</p>

	<p><b>GEAR AND WHEEL PULLER</b></p> <p>P/N 3287732 By clamping the two fingers of this tool around the gear and tightening the bolt against the gear shaft, the gear will be forced off the shaft.</p>
	<p><b>TAPE PUNCH</b></p> <p>P/N 3033455 - Punch Used to punch 718 carriage control tapes.</p>
	<p><b>TAPE PUNCH</b></p> <p>P/N 3033454 - Knob Used with Tape Punch, P/N 3033455</p>
	<p><b>6 LB. SCALE</b></p> <p>P/N 3033432 Check drive belt tension of tape drive motors.</p>

 A long, thin metal rod with a crossbar at one end, used for pulling dowels.	<p>DOWEL PULLER</p> <p>P/N 3135035</p> <p>Used for removing large dowels on the 718 Line Printer</p>
 A long-handled brush with a dark, curved head, used for cleaning.	<p>BRUSH</p> <p>P/N 3033430</p> <p>Use to clean 718 type wheel and the PRRE processing pot</p>
 A metal C-clamp with a sliding mechanism, used for clamping.	<p>"C" CLAMP</p> <p>P/N 3135036</p> <p>Used to remove and insert the tapered pins in the moving coil linkage in the Tape Drives</p>
 A dial indicator with a long, thin rod and a base, used for measuring travel distance.	<p>DIAL INDICATOR AND STAND ASSEMBLY</p> <p>P/N 3135045</p> <p>P/N 3143855 - Dial Indicator</p> <p>P/N 3143856 - Dial Holder Pad</p> <p>Used to measure travel distance of mechanical devices which have no fixed reference point.</p>



## Chapter V

# DRILLS, REAMERS, TAPS, AND COUNTERSINKS

### 5.1 INTRODUCTION

The accurate drilling and reaming of metals and the tapping of holes depends largely upon the user's knowledge of the tools required to perform these functions. If these tools are properly used and cared for, a higher quality of workmanship will be obtained. This chapter contains information relative to the use and care of these tools.

### 5.2 TWIST DRILLS

Twist drills are the most common tools used in drilling metal and are made in many different sizes and lengths. These drills are made of carbon steel or high-speed alloy steel. Carbon steel drills are used for general drilling while the alloy steel drills are used for drilling hard metals such as stainless steel.

#### 5.2.1 Drill Terminology

A twist drill (fig. 5-1) is composed of three main parts: point, body, and shank. The point of a drill is the cone-shaped end (normally 31 degrees) which does the actual cutting. The body is the center section of the drill between the point and shank. The cut-out portions of the body are called flutes. These flutes serve a definite function in that they cause the metal chip to curl tightly within itself occupying a minimum amount of space, and they also allow lubricants to flow easily down to the cutting edge. The shank of the drill is the end that fits into the drill chuck.

The actual cutting is done by the cutting lips or edges which are formed by the intersection of the flutes and the cone-shaped point. The dead center of the drill is the edge at the extreme tip of the point. The dead center should always be in the exact center of the drill axis. When drills are re-ground, it is possible to have the dead center point off center resulting in one cutting lip doing most of the cutting and placing excessive strain on the drill. The narrow strip at the edge of each blade is called the margin. This strip, which extends the entire length of the flutes, is part of a cylinder interrupted by the flutes. The actual drill diameter is measured from margin to margin.

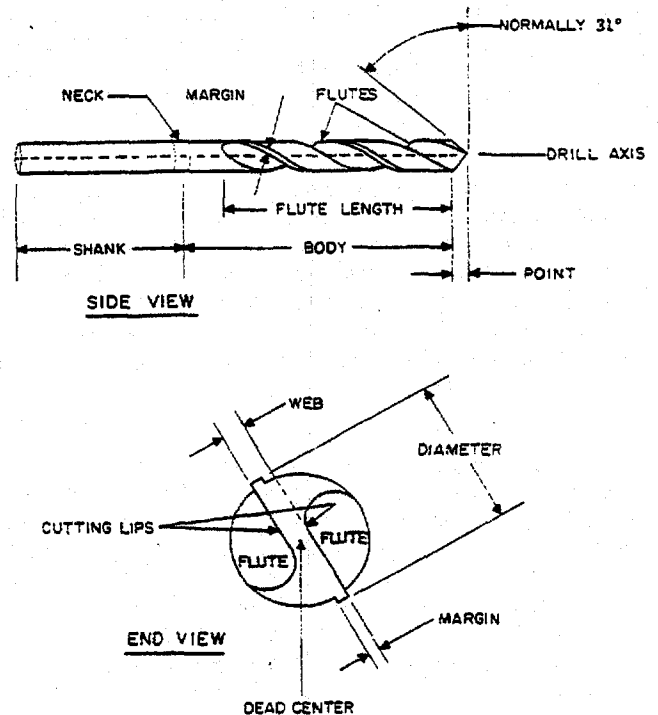


FIGURE 5-1. DRILL TERMINOLOGY

#### 5.2.2 Drill Sizes

The twist drills available at the sites are designated in two different ways:

- Fractional Sizes - These drills come in sizes from 1/32 inch to 1/2 inch. The difference between one drill size and the next larger or smaller size is always 1/64 inch.
- Numbered Sizes - These drill sizes vary from #1 (0.2280 inches) to #80 (0.0135 inches). The smallest numbered size drill stocked at the sites is #60 (0.0400 inches).

If the size number, which is etched on the drill shank, has worn off, the drill size can be obtained by using a micrometer. Measure the drill from margin to margin on the drill body near the shank

end. This shank diameter is usually a few thousandths of an inch smaller than the point diameter.

### 5.2.3 Using the Drill

Prior to performing the job the proper size drill bit and drill motor must be selected. Tables 3 and 4 in the Appendix list the various drill bits available. There are two drill motors (fig. 5-2) available at the site. one, a high-speed, 1/4inch capacity drill motor, is used for general drilling of hard metals; the other, 1/2 inch capacity, is used for drilling large holes. The motor of the 1/2inch capacity drill is geared down to prevent overheating of the drill bit.

The object to be drilled should be held in a vise when possible. Never attempt to hold the work with your hands. The drill may catch or jam and start the stock spinning. When this occurs the stock may fly loose and injure personnel in the immediate area. When drilling thin sheet stock, back up the stock with a piece of wood to prevent the stock from being bent out of shape.

When the location of the desired hole is selected, it should be center punched. This will aid the drill in starting to cut and will prevent it from wandering. Turn the drill chuck a few times by hand before turning on the power to insure that the drill bit is properly installed. Keep the drill cutting at all times while in contact with the metal. A steady and uniform pressure should be applied at all times to insure continuous cutting. The drill will become excessively hot if permitted to turn on the metal without cutting. When the drill point is about ready to break through the metal, ease up on the pressure. This point is noted by the difference in pressure and cutting feel. Don't permit the drill to project through the hole. When the hole is complete, remove the drill immediately by pulling it back as it continues to turn in a clockwise direction.

A drilled hole will often have rough edges or burrs on both surfaces. To remove these, select a drill bit twice the size of the hole and hand rotate the point against the burrs. When possible insert the drill bit in a file handle when performing this job. Be careful not to de-burr the hole too much. The hole should be a true cylinder and not countersunk.

When the hole to be drilled is large, a pilot or guide hole should be drilled first. This small hole will help guide the larger drill and will also prevent the larger drill from wandering across the metal.

### 5.2.4 Removing Rivets

To remove a defective rivet (fig. 5-3) or to disassemble a unit joined by rivets, use the following procedure:

- a. Select a twist drill equal in size or smaller than the rivet shank.
- b. Drill into the exact center of the head to a depth equal to the head thickness.
- c. Insert a pin punch in the hole and pry off the rivet head.
- d. Drive the rivet shank out of the metal with a pin punch.

### 5.2.5 Drilling Safety Practices

A misused drill can result in personal injury. When performing a drilling operation, the following safety precautions should be adhered to:

- a. Be sure that the drill selected is of the proper size, free of rust, and that the flutes are clean.
- b. Keep the drill bit tight in the chuck.
- c. Be sure that the drill motor switch is off when inserting the line cord into the receptacle.
- d. Never use a bent drill.
- e. Be certain that the cutting edges and point are not dulled.
- f. Be sure that the metal stock is properly secured.
- g. Always wear safety glasses.
- h. Turn off the drill motor before laying it down.

## 5.3 REAMERS

Reamers are used to smooth and true previously drilled holes and to enlarge existing holes a small amount.

The reamer (fig. 5-4) is composed of three parts: shank, body, and cutting lips. The shank is the driving end of the reamer and is driven by hand using a tap wrench. The body, which is similar to a twist drill, is made up of flutes, lands, and margins. (Reamers used at the sites have straight instead of spiraled flutes.) The lands are the part between the flutes. The cutting lips are the part of the reamer that does the actual cutting. The reamers stocked at the sites are taper reamers and are

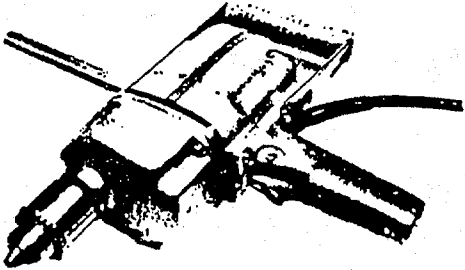
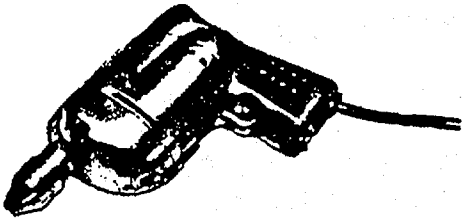

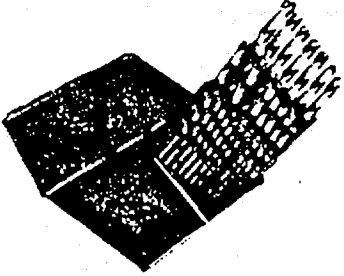
	<p>ELECTRIC DRILL - 1/2-INCH CAPACITY</p> <p>P/N 3287604</p>
	<p>ELECTRIC DRILL - 1/4-INCH CAPACITY</p> <p>P/N 3287603</p>
	<p>TWIST DRILLS</p> <p>Refer to Tables 3 and 4 in the Appendix for sizes and part numbers.</p>
	<p>TWIST DRILL HOLDER</p> <p>P/N 3034820 - Holder and Fractional Drills ( 1/32 to 1/2)</p> <p>P/N 3034813 - Holder and Numbered DRILLS (1 to 60)</p>

FIGURE 5-2. DRILLS AND ACCESSORIES

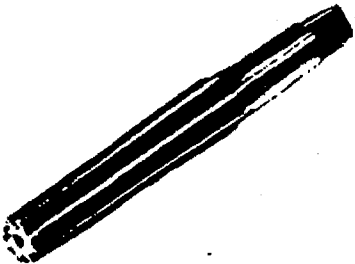
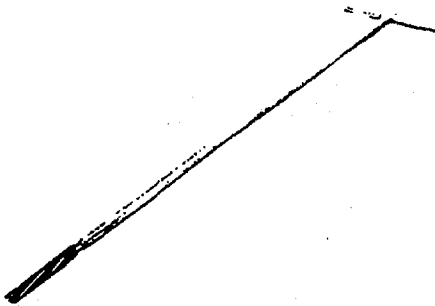
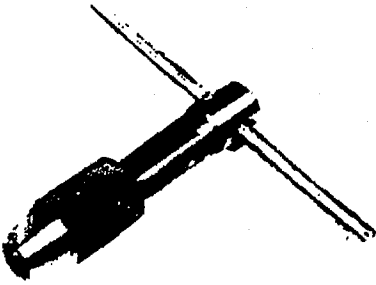
	<p>REAMERS, HAND TAPER</p> <p>Refer to Table 7 in the Appendix for sizes and part numbers.</p>
	<p>EXTENSION TAPER REAMER</p> <p>Refer to Table 8 in the Appendix for sizes and part numbers.</p>
	<p>TEE HANDLE</p> <p>P/N 3355708</p> <p>Use with taper reamer P/N 3355707</p>

FIGURE 5-2. DRILLS AND ACCESSORIES (cont'd)

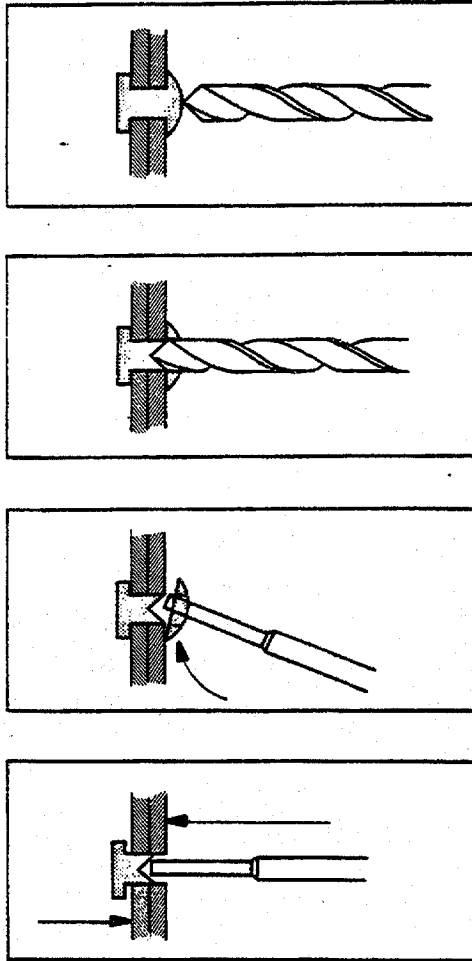


FIGURE 5-3. REMOVING A RIVET

used primarily for the truing of taper pin holes. They are available in a variety of sizes.

Reamer blades are hardened to such an extent that they are brittle and will chip if care is not exercised when using them. A hole to be reamed to an exact size must be drilled about 0.001 to 0.003 inch undersize. A cut that removes more than 0.001 inch places an unnecessary strain on the tool. On the other hand, allowing insufficient stock to be removed will result in burnishing rather than reaming the hole. When using a reamer never rotate it counterclockwise. This dulls the cutting blades. Always rotate the reamer in the same direction (clockwise) whether cutting or removing the tool. Turning the reamer steadily and evenly will prevent chattering or marking of the hole walls.

Reamers should always be handled with care. Never drop one or roll it across a table. When not

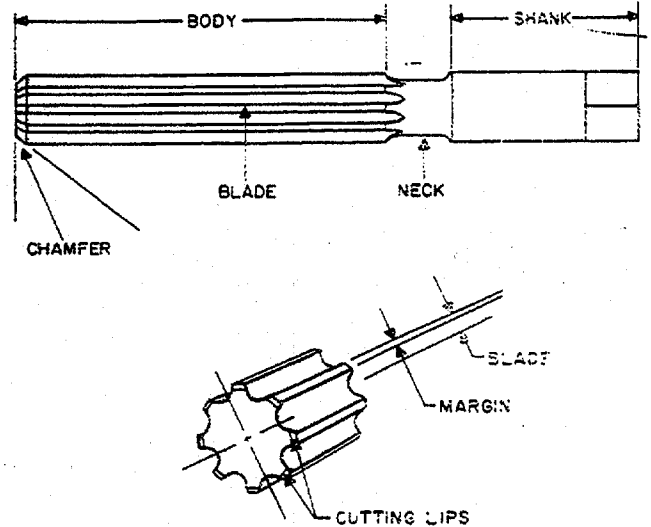


FIGURE 5-4. REAMER TERMINOLOGY

in use, the reamer should not be left lying around; it should be placed in the proper storage location.

### 5.3.1 Taper Reamers

The reamers available at the sites are primarily used for reaming taper pin holes. Since the diameters of taper pins differ, the exact size of the pin must be determined in order to select the proper size drill and reamer.

Eight basic taper pins are stocked at the site (fig. 5-5). Seven of these pins (sizes 3-0 to 5) are three inches long and are primarily used in the card machines and tape drives. The eighth pin (size 2-0) is 1-5/16-inches long. In addition to these basic pins, a number of pins are available sized to the proper length for a particular location. If a pin must be replaced and the proper pin is not stocked, then a pin must be cut and fitted from one of the eight basic pins.

### 5.3.2 Installing a Taper Pin

To install a taper pin, first determine the size and length desired. After the desired pin is obtained, measure the diameter of its small end and drill that size hole in the metal. Select the proper size reamer by measuring both ends of the taper pin and determining the size reamer required by referring to Tables 7 and 8 in the Appendix. The small end of the reamer should just enter the drilled hole. During the process of reaming the hole, test fit the taper pin several times. The taper pin when driven in place should project 1/64 to 1/16 inch at the large end and be recessed by the same amount at the small end. The pin is then inserted into the hole and driven in place using a repairman's brass-rod P/N 3033358 and the proper weight hammer.

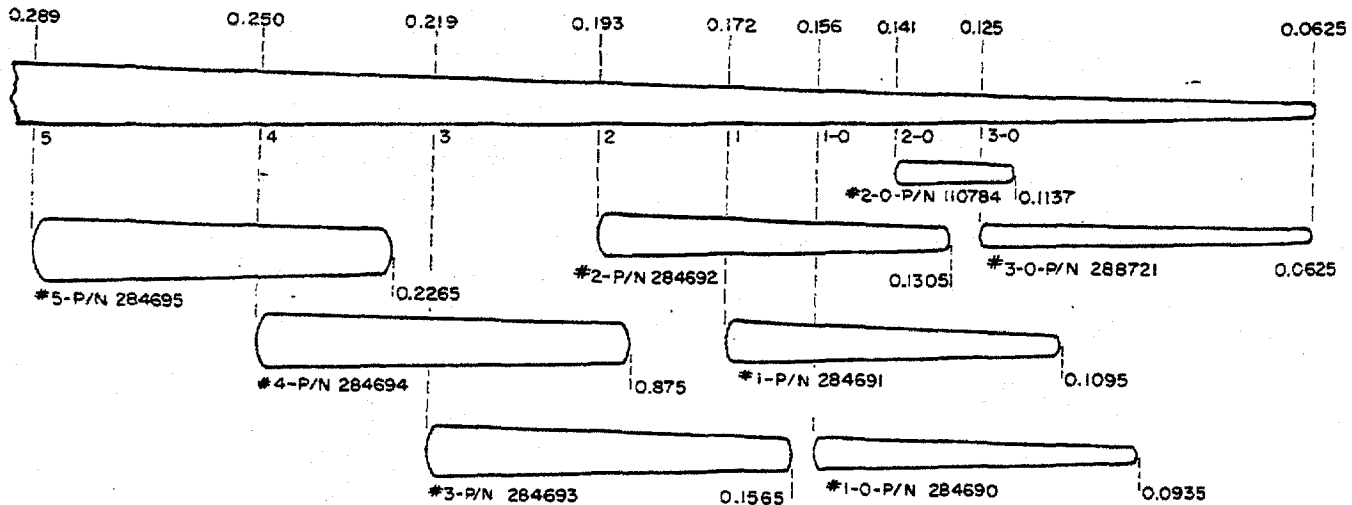


FIGURE 5-5. TAPER PIN SIZES

#### 5.4 TAPS

A tap is a tool used to produce internal threads to receive screws, bolts, or other threaded components.

The general shape of hand taps and the terminology applicable to these taps is illustrated figure 5-6. The body of the tap is the portion of the fluted section that cuts the full thread. The chamfered portion of the body is the section where the threads are tapered. This taper is necessary to start the tap in the hole. The shank is the upper part of the tap and is square at the end to fit the tapwrenches.

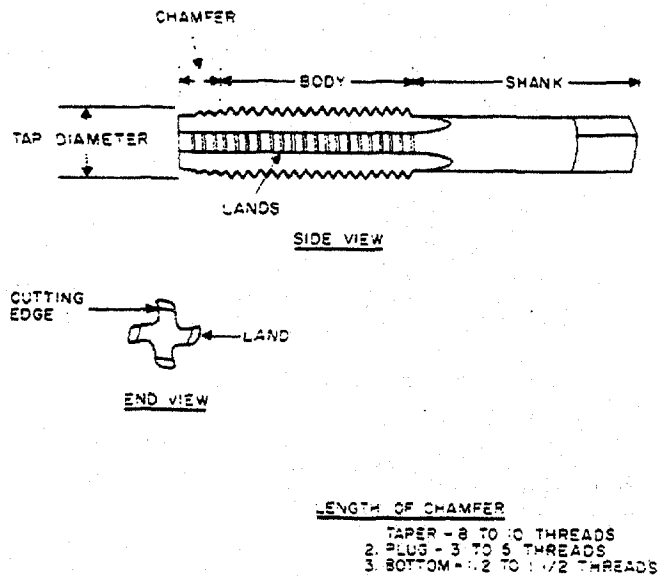


FIGURE 5-6. TAP TERMINOLOGY

Three different types of hand taps are available for site use: taper, plug, and bottoming taps. The only difference among these three taps is the amount of chamfer at the end. Taper taps are tapered approximately 8 to 10 threads from the end; plug taps, 3 to 5 threads; bottoming taps, 1/2 to 1-1/2 threads.

The taper tap is used to begin the tapping process. This tap is easy to start cutting with and to keep aligned because of the large taper of the end. When working with thin stock or when the hole to be tapped is completely through the metal, this tap is the only one required.

When working with thick metals, the taper tap is used to start the cut and the plug tap to complete the job.

When tapping a blind hole, all three taps must be used; the taper tap to start the cut, the plug tap to complete the cutting (except the final few threads), and the bottoming tap to thread the hole to the bottom. It is not necessary to use this method of tapping a blind hole, but it reduces the possibility of breaking a tap or of having a misaligned thread.

##### 5.4.1 Use of Taps

Prior to using a tap, the proper size hole must be drilled. In selecting the tap drill (same as a twist drill), the percent of thread contact must be considered. For site use, a 75 percent thread contact is the most common (75 percent of the screw thread and hole thread are in contact). Table 5 in the Appendix lists the tap drills that are to be used with the specified taps. Clearance (or body) drills are also called out in this table. These drills are used to drill a hole slightly larger than the screw size

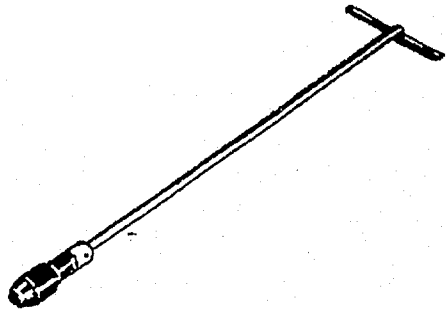
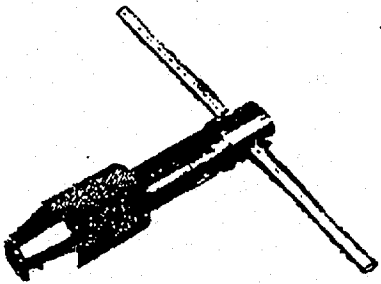
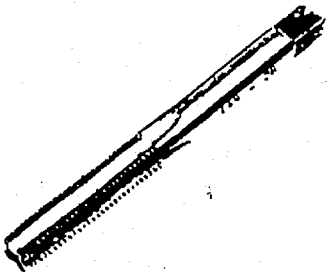
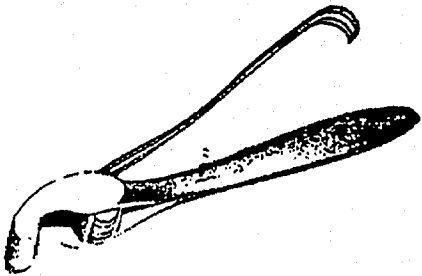
	<p>TAP WRENCH - LONG</p> <p>P/N 3033373</p>
	<p>TAP WRENCH - SHORT</p> <p>P/N 3143851 - 1/16 to 5/32 inch P/N 3143852 - 5/32 to 1/4 inch</p>
	<p>TAPS</p> <p>Refer to Table 5 in the Appendix for sizes and types available.</p>
	<p>STRAP WRENCH</p> <p>P/N 3204489</p>

FIGURE 5-7. TAPS AND TAP WRENCHES

where an untapped screw hole is desired.

After the tap hole is drilled, the desired tap and tap wrench (fig. 5-7) are selected. The stock is then mounted in a vise if not firmly anchored to a unit. Insert the tap into the hole. Be sure that the tap is not angled by using a combination square, and mount the tap wrench on the square shank of the tap. The tap is then turned in a clockwise direction with sufficient downward pressure to start the tap cutting. Once cutting has begun no additional downward pressure should be applied. Don't turn the tap continuously. It should be turned forward about a quarter turn and then backed up until the chips break loose, then forward again. This process should be repeated until the hole is completely tapped. When tapping a blind hole, be sure that the tap is not forced to turn alter the bottom of the hole has been reached. Taps are very brittle, they will snap easily and are difficult to remove from a hole. Never attempt to drill a hole in a broken tap as the tap is made of a harder metal than the drill bit and will damage the drill.

#### 5.4.2 Care of Taps

Taps are cutting tools which, because of their brittleness and hardness, will break unless properly handled. Several basic rules to follow when using the tap are as follows:

- a. Never attempt to cut threads in hardened metal. The results will be a broken, chipped, or dulled tap.
- b. Tap small holes very carefully. Avoid any erratic motion or overpower.
- c. Align the tap properly in the hole.
- d. Use only a sharp tap. Dull taps should be returned to the stockroom for sharpening.
- e. Use a sufficient amount of lubricant while cutting threads.
- f. When tapping a blind hole, drill sufficiently deep so there is room for chips at the bottom of the hole.
- g. Remove all chips from a blind hole before using the bottoming tap.
- h. Select the proper size tap and tap wrench.
- i. Be sure that the tap is clean and free of excess lubricant before returning it to the stockroom.
- j. Don't leave taps lying around; place them in the proper storage location when not in use.

### 5.5 COUNTERSINKS

Countersinks are used to bevel the end of drilled holes to fit screw and bolt heads of the countersink type. The countersink stocked at the sites is equipped with a micrometer adjustment (adjustable to .001-inch) and a stop pin that prevents the countersink from cutting deeper than the desired depth. The micrometer adjustment of this tool is calibrated and operates identically to the micrometer caliper described in 3.4.5 of this manual.

The countersink is designed to hold a variety of sizes of cutting heads, both in 82° and 100° point angles. The reason for the two different point angles is that, at a site, screws and bolts are available with two different types of countersunk heads (fig. 5-8). The countersink cutting heads are also designated according to the size of the hole being countersunk, which is, in effect, the minor diameter of the screw that will be used. This measurement is the diameter of the countersink cutter pilot. The purpose of the pilot is to insure that the countersunk hole is concentric with the screw hole.

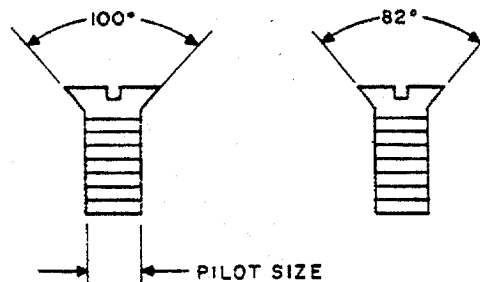


FIGURE 5-8. COUNTERSINK ANGLES

The micrometer stop countersink tool and the various cutting heads are illustrated in figure 5-9.

#### 5.5.1 Using the Countersink

The following procedure is employed when using the countersink:

- a. When using the countersinks always wear safety glasses.
- b. Select the desired countersink cutter according to point angle and pilot size.
- c. The countersink unit is then attached to a drill motor.
- d. Adjust the micrometer stop to the desired depth. This will be slightly more than the thickness of the head. Head thickness measurements for most of the screws available at the site will be found in the Coded Parts List.
- e. Be sure that the unit is properly secured

- in the drill chuck before turning on power.
- f. Hold the countersink guard in the left hand and the drill motor in the right hand. Never turn on power without holding the countersink guard.
  - g. When possible, countersink a test hole in scrap stock to insure that the dimensions are correct.
  - h. Countersink the hole approximately half way, then remove the tool and check the hole.
  - i. Countersink the remainder of the hole until the guard collar rests on the metal.
  - j. Examine the finished job to insure that the hole is round and even and that the screw fits properly.


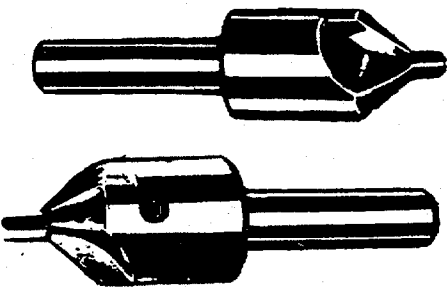
	<p>MICROMETER STOP COUNTERSINK</p> <p>P/N 3204375 - Countersink Tool P/N 3204386 - Complete Kit</p>																																	
	<p>COUNTERSINK CUTTERS</p> <table><tr><th></th><th>Point Angle</th><th>Pilot Diameter</th></tr><tr><td>P/N 3204376</td><td>- 82 -</td><td>.098 in.</td></tr><tr><td>P/N 3204377</td><td>- 82 -</td><td>.128 in.</td></tr><tr><td>P/N 3204378</td><td>- 82 -</td><td>.159 in.</td></tr><tr><td>P/N 3204379</td><td>- 82 -</td><td>3/16 in.</td></tr><tr><td>P/N 3204380</td><td>- 82 -</td><td>1/4 in.</td></tr><tr><td>P/N 3204381</td><td>- 100 -</td><td>.098 in.</td></tr><tr><td>P/N 3204382</td><td>- 100 -</td><td>.128 in.</td></tr><tr><td>P/N 3204383</td><td>- 100 -</td><td>.159 in.</td></tr><tr><td>P/N 3204384</td><td>- 100 -</td><td>3/16 in.</td></tr><tr><td>P/N 3204385</td><td>- 100 -</td><td>1/4 in.</td></tr></table>		Point Angle	Pilot Diameter	P/N 3204376	- 82 -	.098 in.	P/N 3204377	- 82 -	.128 in.	P/N 3204378	- 82 -	.159 in.	P/N 3204379	- 82 -	3/16 in.	P/N 3204380	- 82 -	1/4 in.	P/N 3204381	- 100 -	.098 in.	P/N 3204382	- 100 -	.128 in.	P/N 3204383	- 100 -	.159 in.	P/N 3204384	- 100 -	3/16 in.	P/N 3204385	- 100 -	1/4 in.
	Point Angle	Pilot Diameter																																
P/N 3204376	- 82 -	.098 in.																																
P/N 3204377	- 82 -	.128 in.																																
P/N 3204378	- 82 -	.159 in.																																
P/N 3204379	- 82 -	3/16 in.																																
P/N 3204380	- 82 -	1/4 in.																																
P/N 3204381	- 100 -	.098 in.																																
P/N 3204382	- 100 -	.128 in.																																
P/N 3204383	- 100 -	.159 in.																																
P/N 3204384	- 100 -	3/16 in.																																
P/N 3204385	- 100 -	1/4 in.																																

FIGURE 5-9. COUNTERSINK TOOL



## Chapter VI

# SOLDERING

### 6.1 INTRODUCTION

Soldering that will meet Air Force requirements of no more than 1 error out of each 500,000 soldered connections requires skilled application and integrity. The success of IBM's reliability factor may depend on a satisfactory soldered connection. Consider this down-time comparison. The time spent to find a defective tube, resistor, transformer, or other component part averages half an hour. Isolating a poor soldered connection can take eight hours or longer.

Solder is one of the oldest and most useful of alloys. Because of the ease with which it has been used, few people have bothered to acquire the basic, but necessary, background for good soldering techniques. Soft solder is a fusible alloy mainly composed of tin and lead. This alloy makes it possible to join two or more metals at temperatures well below their melting point. The solder-to-metal attachment is formed by an inter-metallic-compound phase which takes place at comparatively low temperatures. The solvent action of hot solder on copper or steel resembles the action of a few drops of water on salt. The solder dissolves microscopic particles of the copper or steel, forming a chemical attachment instead of physical adhesion. Therefore, heating the soft flexible solder during the soldering act causes a chemical change to take place which results in a hard metal alloy. Thus when two or more pieces of metal are soldered together, a joint is formed which acts like one continuous piece of metal. (This is not true of a pure physical connection, such as a bolt or spring, because a layer of oxides always remains between the surfaces.) In addition, the solder alloy withstands the stress and strain of the temperature changes without rupture of the joint.

The primary purpose of a soldered joint is to achieve an airtight metallic connection by means of a film of solder alloy, varying in thickness from 0.002 to 0.004 inch between the metal parts: i.e., wire and terminal. When such a connection has been made, it is a waste of time and material to add solder just to improve its appearance; the electrical conductivity has been established with the original bond and will be unaffected by the addition of solder.

### 6.2 SOLDERING TOOLS

Soldering tools are illustrated in figure 6-1. Five different soldering irons with interchangeable tips, transformers (6.3VAC), heat shunts, soldering iron holders, soldering aids, and an electric solder pot comprise the soldering tools stocked at field locations. The 6.3VAC soldering irons are to be used with the available transformer which has four wattage taps: 26, 29, 32, and 35. Always use the lowest wattage necessary for the work. In most cases 26 watts will be sufficient for electrical soldering.

The interchangeable copper tips are coated with iron, .008 inch thick, to reduce scaling and wear caused by tin-copper alloying. The tip is pre-tinned by dipping into pure tin. These tips should never be filed. To clean the tip and remove oxidation wipe it with a cleaning pad.

The heat shunt is provided for use when working with delicate precision components such as transistors, diodes, miniature capacitors, and chokes. The excessive heat of the soldering iron will damage the component if the heat shunt, which dissipates heat, is not used.

### 6.3 BASIC SOLDERING TECHNIQUES

The following general rules, while not all-inclusive, are applicable to the majority of soldering work to be performed.

#### 6.3.1 Temperatures

When soldering with rosin core solder, temperatures in excess of 600°F. must be avoided or the rosin will tend to carbonize and hinder rather than aid the soldering operation. Efficient soldering is promoted by using a soldering iron with adequate heat storage capacity. Such a device will maintain proper operating temperature in use. No attempt to solder must be made by heating an undersize or otherwise inadequate soldering iron to excessive temperature.

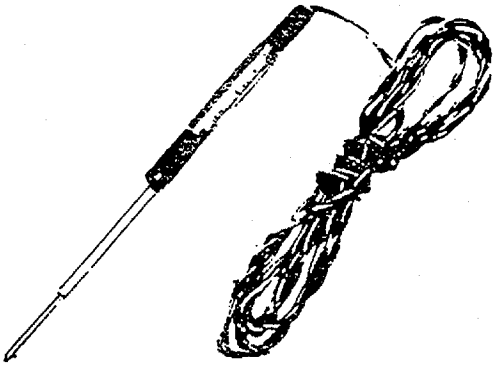
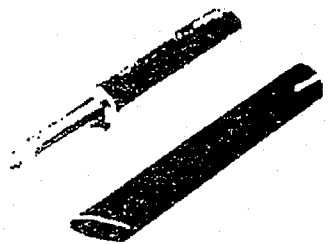
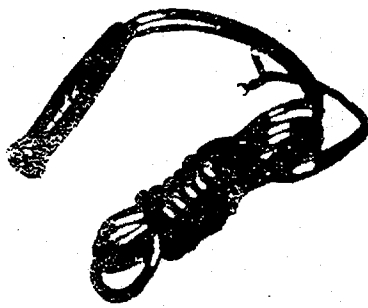
	<p>SOLDERING IRON</p> <p>P/N 3034606 6 volts 10 watts with replaceable tips. (P/N 3034840 and P/N 3034841)</p>
	<p>TIPS</p> <p>P/N 3034840 P/N 3034841</p>
	<p>SOLDERING IRON</p> <p>P/N 3144918 - Handle 6 volts 25-35 watts with replaceable tips.</p>
<p>(NO PHOTO AVAILABLE)</p>	<p>TIPS</p> <p>P/N 3144919 - 3/16-Inch Pyramid P/N 3144920 - 3/16-Inch Chisel</p> <p>Used as replacement tips for soldering iron handle, P/N 3144918</p>

FIGURE 6-1. SOLDERING TOOLS AND ACCESSORIES

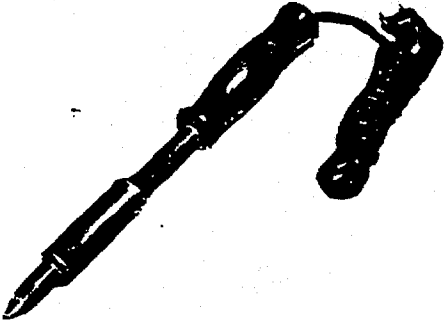


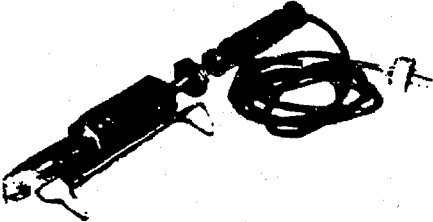
	<p><b>SOLDERING IRON</b></p> <p>P/N 3287764 115 volts 110 watts with replaceable tips. Tips - P/N 3287823</p>
	<p><b>TIP</b></p> <p>P/N 3287823</p>
	<p><b>SOLDERING GUN</b></p> <p>P/N 3034844 - Gun P/N 3117558 - Left Housing P/N 3117557 - Right Housing P/N 3034847 - Tips</p>
	<p><b>SOLDERING IRON</b></p> <p>P/N 3134920 115 volts 550 watts</p>

FIGURE 6-1. SOLDERING TOOLS AND ACCESSORIES (cont'd)

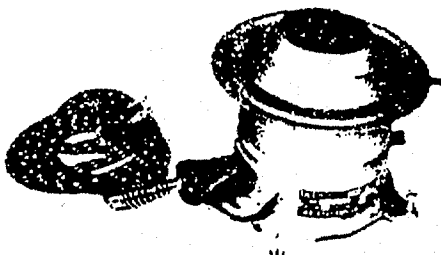
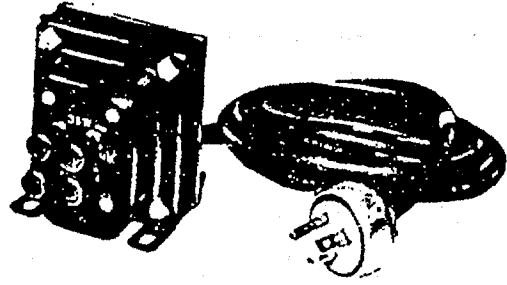
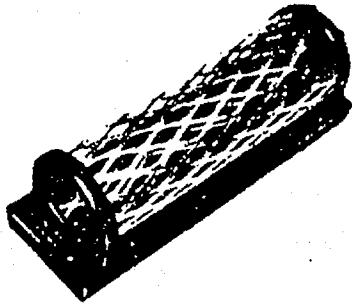
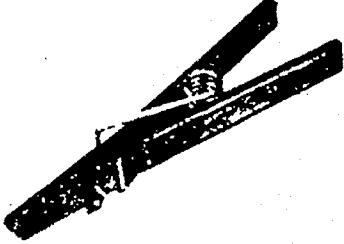
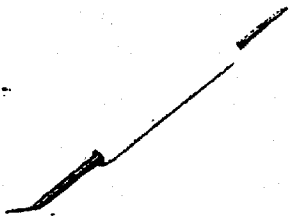
	<p>SOLDER POT</p> <p>P/N 3034831 Used for Dip Soldering</p>
	<p>TRANSFORMER</p> <p>P/N 3034134 - 4 Taps</p> <p>P/N 3034839 - Plastic binding posts</p>
	<p>HOLDER</p> <p>P/N 3287826</p>
	<p>HEAT SHUNT</p> <p>P/N 3033354</p>

FIGURE 6-1. SOLDERING TOOLS AND ACCESSORIES (cont'd)

	<p>SOLDERING AID</p> <p>P/N 3134921</p>
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#### ACCESSORIES

Bar Solder (60/40) P/N 3004311

Roll Solder .032 P/N 3212135  
.045 P/N 3212136  
.062 P/N 3212137

3% Silver Solder P/N 3034899  
Used on oscilloscope ceramic  
terminal blocks.  
Liquid Flux P/N 3097391

### 6.3.2 Heating

The surfaces of the parts to be joined must be heated to a temperature above the flow temperature of the solder (400-600°F. for 60/40 flux cored solder). The joint will reach this temperature in less than 30 seconds. The more massive portion of the joint should be heated first, allowing the heat to be conducted to the less massive portion. Heat may be applied by soldering iron, molten alloy bath, or other suitable means. When using cored wire solder, the end should be kept open. To be effective, the flux must flow before the solder melts when touched to the joint. Flux core solder should never be flowed from the soldering iron to the joint (fig. 6-2). The application of heat should be carefully controlled during the soldering operation to prevent damage to other components of an assembly, such as fabric and insulation material.

#### NOTE

When working on vertical terminals, tin only one surface of the iron to restrict solder flow to that side.

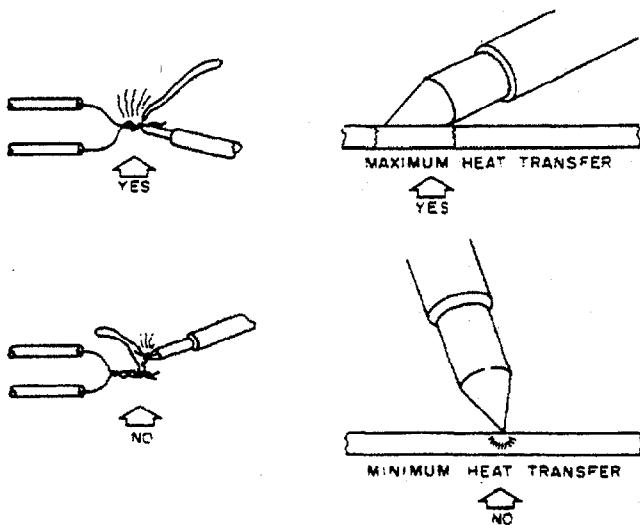


FIGURE 6-2. USING THE SOLDERING IRON

### 6.3.3 Cooling.

Liquids are not to be used to cool a soldered joint. By using proper solder and soldering techniques a joint will not become so hot that it needs rapid cooling to prevent the wire insulation from charring. In special cases involving assemblies with polystyrene or other low melting

point insulation, the insulation may be placed in a cooling bath. However, in no case should the cooling medium contact the soldered joint.

### 6.3.4 Copper Bit Soldering Irons

The heat transmitting ability of copper-bit soldering irons is seriously impaired by the formation of oxides on the bit surface. The formation of such oxides can be effectively retarded by maintaining a liberal coating of solder on the surface of the bit.

Plated tips resist corrosion and last longer because the plating, unlike copper, is not affected chemically by solder. These tips should not be filed or ground on the bench grinder. If cleaning is required, the point of the iron should be dipped in flux and retinned.

### 6.3.5 Flux Residue Removal

After the joint has cooled, the residues from active fluxes can be completely removed or neutralized using Methylene Chloride, P/N 3034905 or Tecsolv 928, P/N 3034686.

## 6.4 SOLDERING SAFETY PRACTICES

The following safety practices shall be observed when soldering:

- Safety glasses or appropriate eye protection must be worn while soldering.
- The soldering iron should be placed in the holder when not being used.
- Never try to remove solder from the iron by flicking the iron. This can put solder in the eyes and on clothes; it can also put a short in equipment. Use the cleaning pad provided.
- Be careful to pick the iron up by the handle. Never point with the iron or use it as a tool to straighten terminals.
- Unplug the iron if it is not to be used for a period of time.
- When returning the soldering iron to stock, be sure that all excess solder is removed. It is a good practice to loosen the tip of the iron when not in use; this prevents the tip from corroding tight on the handle.

## Chapter VII

### PAINT APPLICATION

#### 7.1 INTRODUCTION

The application of paint to metallic sections of the SAGE Computer does not affect the usability or operation of the equipment. However, it does protect the equipment from corrosion, aids in keeping the equipment clean, protects newly stamped information, and creates a pleasant working atmosphere.

To insure that all painting accomplished at the sites meets high quality workmanship standards, the proper method of paint application (both brush and spray) will be explained in this chapter.

#### 7.2 PRE-TREATMENT

Whenever it is necessary to apply paint to a metallic surface that was not previously painted, or to painted surfaces which contain areas of bare metal (chips, mars, etc.), the metal must be pre-treated to prevent corrosion and to insure a good bond between the finish paint and the metal. The method and type of pre-treatment is determined by the type of metal being painted and its condition. This information is available in the paint specifications contained in FED 256.

#### 7.3 BRUSH PAINTING

Under normal conditions, brush painting will only be used when the area to be painted is very large. Most touch up work will be done by spray painting. The procedure to use when brush painting is as follows:

- a. Clean the metal to be painted, using approved cleaning agents. AU grease, rust, etc., must be removed. Corroded areas can be sanded using 220 grit or coarser sand paper.
- b. Apply one coat of zinc chromate primer (P/N 3034741). allow to dry.
- c. Apply paste filler (P/N 3034740) where required and allow it to dry.
- d. Sand filled areas if required. (Use a fine grit sandpaper. Preferably 240 or

600 grit.)

- e. Apply one coat of grey primer sealer (P/N 3034742) and allow it to dry.
- f. Apply the final coat of the desired color. First brush in one direction, then finish by brushing in a direction 90 degrees from the first application. It is better to apply two thin coats, 90 degrees from each other, than one heavy coat.

#### Note

Drying time can be accelerated by using the infra-red lamp P/N 3034800.

#### 7.3.1 Care of Paintbrushes

A paintbrush is made up of three parts: handle, ferrule, and bristles. The ferrule is the metal band holding the bristles in place and to the handle. The heel of the bristles is the portion of the bristles adjacent to the ferrule.

To keep a brush in good shape, clean paint or enamel from it after each use. Work it out in turpentine or its equivalent. In doing this, avoid pressing the brush down edgewise on the bristles as this will force them out of shape. Work the solvent well into the heel. To remove paint clinging to the bristles, lay the brush flat on a board and scrape the bristles carefully with a blunt knife. Work the solvent in again and scrub out the loose paint, working from the ferrule toward the tip of the brush. Rinse again in thinner and rinse out as much as possible. Never use paint remover as it will ruin a brush.

#### 7.4 SPRAY PAINTING

Spray painting is perhaps the most convenient method of applying paint to any given surface. There are no brushes to clean and no paint to mix or stir. Just a shake of the aerosol can and the pressing of the paint release button accomplishes the painting task. To better understand how to use a spray paint a brief description of its operation is necessary.

### 7.4.1 Aerosol Can Operation

Spray cans (fig. 7-1) contain about 50 percent paint; the remainder of the contents is a liquid gas. This liquid gas is mixed with the paint and is the propellant that forces the paint from the can.

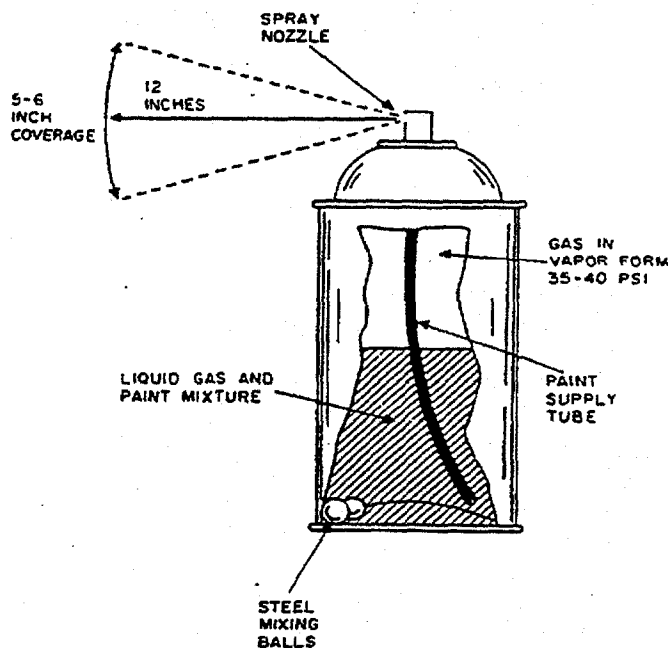


FIGURE 7-1. AEROSOL SPRAY CAN

### 7.4.2 Using Aerosol Paint

Prior to using a spray paint, always read the manufacturer's instructions which will usually provide all the information necessary. To assure even color and a smooth spray, shake the can to mix the paint. The majority of spray cans contain several steel balls that, when agitated, mix the paint. A good indication of complete mixing of the paint is the sound of the steel balls moving freely within

the can. If the paint is not completely mixed, the sound will be somewhat muffled. When the paint is first removed from stock, continue to agitate the can for a few minutes after hearing the steel balls to insure a complete mixture of the pigment.

Before spraying the desired surface, spray some paint on a piece of paper or scrap material. A can that has been standing for a period of time may give an intermittent spray for a short period of time before operating smoothly. Hold the spray can as parallel to the work as possible at a distance of approximately 12 inches. Move the spray across the area to be painted triggering the spray as it approaches the near end of the area to be painted and releasing the pushbutton as it passes beyond the far edge of the work. With the majority of paints it is best to apply two thin coats rather than one heavy coat. However, wrinkle paints must be applied in one coat. This coat must be heavy enough to cover the area and still not sag or run.

If there is paint in the can but only gas is released when the spray is triggered, it is possible that the can is being held in such a position that the paint supply tube is positioned incorrectly. To correct this, attempt to hold the can in a more vertical position or if this is not possible rotate the spray valve a slight amount. This will rotate the supply tube into the paint.

When the job is complete, clean the spray nozzle before returning the can to stock. This is accomplished by inverting the can and depressing the pushbutton until only gas is emitted from the spray nozzle.

Often the area to be painted is adjacent to a component or some surface that should not be painted. These areas should be covered before painting. A method of controlling what is painted is to use a piece of cardboard with a hole cut into it a little larger than the area to be painted. Hold the card a few inches from the surface and spray through the hole in the card.

**Appendix**  
**CHARTS AND TABLES**

◀ PAGES 81 AND 82 DELETED

LIST OF TABLES

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TABLE 1. DECIMAL EQUIVALENT CHART

$1/64$ ____ .0156	$33/64$ ____ .5156
$1/32$ ____ .0313	$17/32$ ____ .5313
$3/64$ ____ .0469	$33/64$ ____ .5469
$1/16$ ____ .0625	$9/16$ ____ .5625
$5/64$ ____ .0781	$37/64$ ____ .5781
$3/32$ ____ .0938	$19/32$ ____ .5938
$7/64$ ____ .1094	$39/64$ ____ .6094
$1/8$ ____ .1250	$5/8$ ____ .6250
$9/64$ ____ .1406	$41/64$ ____ .6406
$5/32$ ____ .1563	$21/32$ ____ .6563
$11/64$ ____ .1719	$43/64$ ____ .6719
$3/16$ ____ .1875	$11/16$ ____ .6875
$13/64$ ____ .2031	$45/64$ ____ .7031
$7/32$ ____ .2188	$23/32$ ____ .7188
$15/64$ ____ .2344	$47/64$ ____ .7344
$1/4$ ____ .2500	$3/4$ ____ .7500
$17/64$ ____ .2656	$49/64$ ____ .7656
$9/32$ ____ .2813	$25/32$ ____ .7813
$19/64$ ____ .2969	$51/64$ ____ .7969
$5/16$ ____ .3125	$13/16$ ____ .8125
$21/64$ ____ .3281	$53/64$ ____ .8281
$11/32$ ____ .3438	$27/32$ ____ .8438
$23/64$ ____ .3594	$55/64$ ____ .8594
$3/8$ ____ .3750	$7/8$ ____ .8750
$25/64$ ____ .3906	$57/64$ ____ .8906
$13/32$ ____ .4063	$29/32$ ____ .9063
$27/64$ ____ .4219	$59/64$ ____ .9219
$7/16$ ____ .4375	$15/16$ ____ .9375
$29/64$ ____ .4531	$61/64$ ____ .9531
$15/32$ ____ .4688	$31/32$ ____ .9688
$31/64$ ____ .4844	$63/64$ ____ .9844
$1/2$ ____ .5000	$1$ ____ 1.0000

TABLE 2. A. S. M. E. STANDARD SCREWS AND AMERICAN WIRE GAUGE

SCREWS

WIRE

Number  
Outside  
Diameter (inches)  
Threads  
Per inch

Gauge#  
Diameter  
Gauge#  
Diameter

0	0.060	80	6/0	0.5800	16	0.0508
1	0.073	72, 64	5/0	0.5164	17	0.0452
2	0.086	64, 56	4/0	0.4600	18	0.0403
3	0.099	56, 48	3/0	0.4096	19	0.0359
4	0.112	48, 40, 36	2/0	0.3648	20	0.0319
5	0.125	44, 40, 36	1/0	0.3249	21	0.0284
6	0.138	40, 36, 32	1	0.2893	22	0.0253
7	0.151	36, 32	2	0.2576	23	0.0225
8	0.164	36, 32, 30	3	0.2294	24	0.0201
9	0.177	32, 30, 24	4	0.2043	25	0.0179
10	0.190	32, 24	5	0.1819	26	0.0159
12	0.216	28, 24	6	0.1620	27	0.0142
1/4	0.250	28, 20	7	0.1443	28	0.0126
5/16	0.313	24, 18	8	0.1285	29	0.0112
3/8	0.375	24, 16	9	0.1144	30	0.0100
7/16	0.438	20, 14	10	0.1019	31	0.0089
1/2	0.500	20, 12	11	0.0907	32	0.0079
			12	0.0808	33	0.0071
			13	0.0719	34	0.0063
			14	0.0640	35	0.0056
			15	0.0570	36	0.0050

TABLE 3. NUMBERED TWIST DRILLS

Drill No.	Diameter in inches	IBM Part Number	Drill No.	Diameter in inches	IBM Part Number	Drill No.	Diameter in inches	IBM Part Number
1	0.2280	3287641	21	0.1590	3287661	41	0.0960	3287681
2	0.2210	3287642	22	0.1570	3287662	42	0.0935	3287682
3	0.2130	3287643	23	0.1540	3287663	43	0.0890	3287683
4	0.2090	3287644	24	0.1520	3287664	44	0.0860	3287684
5	0.2055	3287645	25	0.1495	3287665	45	0.0820	3287685
6	0.2040	3287646	26	0.1470	3287666	46	0.0810	3287686
7	0.2010	3287647	27	0.1440	3287667	47	0.0795	3287687
8	0.1990	3287648	28	0.1405	3287668	48	0.0760	3287688
9	0.1960	3287649	29	0.1360	3287669	49	0.0730	3287689
10	0.1935	3287650	30	0.1285	3287670	50	0.0700	3287690
11	0.1910	3287651	31	0.1200	3287671	51	0.0670	3287691
12	0.1890	3287652	32	0.1160	3287672	52	0.0635	3287692
13	0.1850	3287653	33	0.1130	3287673	53	0.0595	3287693
14	0.1820	3287654	34	0.1110	3287674	54	0.0550	3287694
15	0.1800	3287655	35	0.1100	3287675	55	0.0520	3287695
16	0.1770	3287656	36	0.1065	3287676	56	0.0465	3287696
17	0.1730	3287657	37	0.1040	3287677	57	0.0430	3287697
18	0.1695	3287658	38	0.1015	3287678	58	0.0420	3287698
19	0.1660	3287659	39	0.0995	3287679	59	0.0410	3287699
20	0.1610	3287660	40	0.0980	3287680	60	0.0400	3287700

TABLE 4. FRACTIONAL TWIST DRILL SIZES

Size	Decimal Equivalent	IBM Part Number	Size	Decimal Equivalent	IBM Part Number	Size	Decimal Equivalent	IBM Part Number
1/32	0.0313	3287610	13/64	0.2031	3287621	3/8	0.3750	3287632
3/64	0.0469	3287611	7/32	0.2187	3287622	25/64	0.3906	3287633
1/16	0.0625	3287612	15/64	0.2344	3287623	13/32	0.4062	3287634
5/64	0.0781	3287613	1/4	0.2500	3287624	27/64	0.4219	3287635
3/32	0.0937	3287614	17/64	0.2656	3287625	7/16	0.4375	3287636
7/64	0.1094	3287615	9/32	0.2812	3287626	29/64	0.4531	3287637
1/8	0.1250	3287616	19/64	0.2969	3287627	15/32	0.4687	3287638
9/64	0.1406	3287617	5/16	0.3125	3287628	31/64	0.4844	3287639
5/32	0.1562	3287618	21/64	0.3281	3287629	1/2	0.5000	3287640
11/64	0.1719	3287619	11/32	0.3437	3287630			
3/16	0.1875	3287620	23/64	0.3594	3287631			

TABLE 5. TAP, TAP DRILL, AND CLEARANCE DRILL SIZES

Tap Size	No. of Threads	** Type	P/N	*Tap Drill	Clear Drill
2	56	B	3034715	51	43
3	48	B	3034731	48	38
4	36	B	3034718	45	32
4	40	B	3034730	43	32
5	40	B	3034729	39	30
6	32	B	3034728	36	27
6	40	B	3034719	33	27
8	32	B	3034726	29	18
8	40	B	3034720	28	7/32
10	24	B	3034721	25	9
10	30	B	3034722	22	9
1/4	28	B	3034717	3	17/64
5/16	32	B	3287787	9/32	23/64
1/4	20	B	3287777	7	17/64
3/8	24	B	3287779	21/64	25/64
10	32	B	3034748	21	9
12	24	B	3034712	17	1
14	24	B	3034716	10	17/64
1/4	20	B	3287768	7	17/64
1/4	24	B	3034713	5	17/64
5/16	18	B	3287769	1/4	21/64
5/16	24	B	3287778	17/64	11/32
3/8	16	B	3287770	5/16	25/64

\* Approximately 75% Full Thread

\*\* B = Bottoming

TABLE 6. SCREW EXTRACTORS

IBM Part Number	Bolt Sizes	Drill Size
3034583	3/16 - 1/4	5/64
3034584	1/4 - 5/16	7/64
3034585	5/16 - 7/16	5/32
3034586	7/16 - 9/16	1/4
3034587	9/16 - 3/4	17/64

TABLE 7. TAPER REAMERS

Reamer Size	Diameter (inches)		P/N
	Large	Small	
7/0	0.0666	0.0497	3287738
6/0	0.0806	0.0611	3287739
5/0	0.0966	0.0719	3287740
4/0	0.1142	0.0869	3287741
3/0	0.1302	0.1029	3287742
2/0	0.1462	0.1137	3287743
0	0.1638	0.1287	3287744
1	0.1798	0.1447	3287733
2	0.2008	0.1605	3287734
3	0.2294	0.1813	3287735
4	0.2604	0.2071	3287736
5	0.2994	0.2409	3287737
11/16	0.6875	0.5313	3355707

TABLE 8. EXTENSION TAPER REAMERS

Reamer Size	P/N	Reamer Size	P/N
5/0	3033392	2	3033394
3/0	3033391	3	3033395
2/0	3033390	4	3033396
0	3033389	5	3033397
1	3033393		

TABLE 9. OPEN END WRENCHES

## F.E. TOOL KIT

Size	P/N
3/16 - 7/32	3287801
7/32 - 1/4	3287802
1/4 - 5/16	3287803
5/16 - 11/32	3287805
3/8 - 7/16	3287804
1/2 - 9/16	3033374

## KIT P/N 3134914

Size	P/N	Size	P/N
1/4 - 5/16	3135017	3/4 - 7/8	3135026
5/16 - 3/8	3135018	7/8 - 15/16	3135027
3/8 - 7/16	3135019	15/16 - 1	3135028
7/16 - 1/2	3135020	1 - 1 1/8	3135029
1/2 - 9/16	3135021	1 1/16 - 1 1/8	3135030
9/16 - 5/8	3135022	1 1/16 - 1 1/4	3135031
5/8 - 3/4	3135024	19/32 - 11/16	3135023
		25/32 - 13/16	3135025

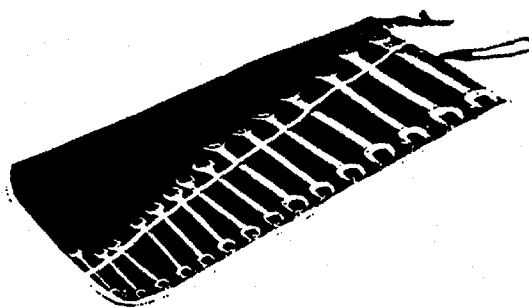


TABLE 10. ADJUSTABLE AND RATCHET WRENCHES

Adjustable		Ratchet	
Size	P/N	Size	P/N
8 in. *	3033367	10 in. **	3134925
10 in.	3287798	15 in. **	3134926

\* F. E. Tool Kit

\*\* Kit P/N 3134945

TABLE 11. BOX WRENCHES

F. E. Tool Kit

Size	P/N
5/16 - 3/8	3033380
7/16 - 1/2	3287799
9/16 - 5/8	3287800

KIT P/N 3034860

Size	P/N	Size	P/N
3/8 - 7/16	3034849	15/16 - 1	3034854
7/16 - 1/2	3034850	1 - 1 1/8	3034858
1/2 - 9/16	3034852	1 1/16 - 1 1/4	3034859
9/16 - 5/8	3034951	19/32 - 11/16	3034855
5/8 - 3/4	3034856	25/32 - 13/16	3034857
3/4 - 7/8	3034853		

TABLE 12. SOCKETS

Size	P/N	Size	P/N
3/16	3287755	3/8	3287759
7/32	3287756	7/16	3033369
1/4	3287757	1/2	3287760
5/16	3287758	9/16	3033370

1/4 inch drive required for these sockets

KIT P/N 3134945 \*

Size	P/N	Size	P/N
1/2	3134932	15/16	3134939
9/16	3134933	1	3134940
5/8	3134934	1 1/16	3134941
11/16	3134935	1 1/8	3134942
3/4	3134936	1 3/16	3134943
13/16	3134937	1 1/4	3134944
7/8	3134938		

\* 1/2 inch drive required for these sockets

KIT 3134951 \*

Size	P/N	Size	P/N
1/4	3135001	7/16 ***	3135016
9/32 **	3135013	1/2	3135006
5/16	3135002	9/16	3135007
5/16 ***	3135014	5/8	3135008
11/32	3135003	11/16	3135009
3/8	3135004	3/4	3135010
3/8 ***	3135015	25/32	3135011
7/16	3135005	13/16	3135012

\* 3/8 inch drive required for these sockets

\*\* 4 point socket

\*\*\* 8 point socket

11/32 - P/N 3034842, 1/4 inch drive required.

TABLE 13. SOCKET HANDLES AND EXTENSIONS

F. E. Tool Kit

Type	P/N
Socket Wrench Handle	3287722
Tee	3287723

Kit - P/N 3134945

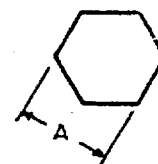
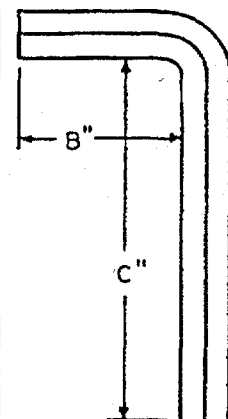
Type	P/N
Sliding Tee	3134927
Extension (3-1/2 inch)	3134928
Extension (5 inch)	3134929
Extension (10 inch)	3134930

Kit - P/N 3134951

Type	P/N
Flexible Hinge	3134947
Sliding Tee	3134948
Extension (3 inch)	3134949
Extension (6 inch)	3134950

TABLE 14. HEX AND FLUTED WRENCHES

PART NUMBER	FLAT WIDTH		LENGTH		USED ON SCREWS	
	A		B	C	SET	CAP
	MAX	MIN	SHORT	LONG		
3034746	.035	.0345	7/16	3	#1, #2	
3287813	.050	.049	9/16	3	#3, #4	#0, #1
3287810	1/16	.062	9/16	3-21/64	#5, #6	#2
3287812	5/64	.077	45/64	3-3/16	#8	#3, #4
3287811	3/32	.093	3/4	3-7/16	#10, #12	#5, #6
3287814	1/8	.124	27/32	3-27/32	1/4	#8
3034601	5/32	.155	15/16	3-15/16	5/16	#10, #12
3287816	3/16	.186	1-1/32	2-27/32	3/8	1/4
3287817	7/32	.217	1-1/8	3-3/32	7/16	5/16
3287818	1/4	.2485	1-7/32	3-11/32	1/2, 9/16	
3287819	5/16	.311	1-11/32	3-27/32	5/8	3/8, 7/16
3034724	3/8	.374	1-15/32	4-11/32	3/4	1/2, 9/16



NOTE: \*  
DIMENSIONS "B" &  
"C" ARE APPROXIMATE  
& ARE FOR REFERENCE  
ONLY.

PART NUMBER	NO. OF FLUTES	DIAMETER A		SHORT LENGTH B	LONG LENGTH C
		MAX	MIN		
3033382	4	.069	.068	9/16	3-3/8
3033456	4	.076	.075	21/32	3-3/32
3033387	4	.094	.093	45/64	3-21/64
3034723	4	.125	.124	7/8	3-27/32
3033457	6	.060	.059	7/16	3
3287807	6	.094	.093	45/64	3-21/64
3287808	6	.110	.109	3/4	3-31/64
3287809	6	.144	.143	27/32	2-27/64

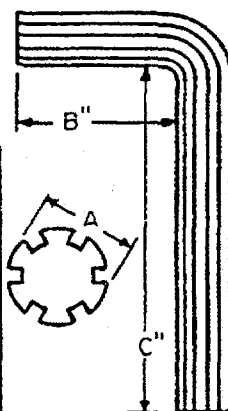


TABLE 15. CHASSIS PUNCHES

	Type	P/N
1/2	Round	3355110
5/8	Round	3034778
11/16	Round	3034779
3/4	Round	3034780
13/16	Round	3355376
7/8	Round	3355223
1	Round	3034781
1 1/16	Round	3034782
1 1/8	Round	3034783
1 5/32	Round	3034784
1 11/64	Round	3034785
1 3/16	Round	3034786
1 1/4	Round	3355109
1 3/8	Round	3034787
1 1/2	Round	3034788
1 5/8	Round	3034789
1 3/4	Round	3034790
1 7/8	Round	3034791
2	Round	3034792
1/2	D	3034794
5/8	D	3034795
2 1/4	Round	3034793

TABLE 16. LUG AND CRIMPING TOOLS

LUG					TOOL			
Type	Wire Size	Stud Size	Manuf. P/N	IBM P/N	Photo Ref.	Manuf. P/N	IBM P/N	Photo Ref. Comments
Butt	26-22		Amp 321029	3002913	18	Amp 48518	3033463	62
Con-nector	22-16		Amp 320559	3099830	59	Amp 49556	3033461	63
	16-14		Burndy YSE 14H	3004933	20	Burndy MR8-33S	3033472	64
	16-14		Amp 320562	3097800	57	Amp 49864	3033464	65
	12-10		Amp 320570	3097801	58	Amp 59062	3033467	62
Contact	20-18		Burndy AYH 14H1	3025281	22	Burndy Y 14 MRC	3033470	66
Tip	16-12		Burndy AYH 12-14H1	3025139	21	Burndy Y 14 MRC	3033470	66
Crabloc	10		Burndy AYH 10	3004539	17	Burndy Y 8 MC	3033869	67
Tip	8		Burndy AYH 8C	3004538	16	Burndy Y 8 MC	3033869	67
Ferrule	coax cable Type 1		T & B GSC 149	3004072	12	T & B WT201-02-03	3033478	68
	3001953		T & B GSB 090	3004071	11			
	coax cable type 2		T & B GSC 156	3002911	6	T & B WT201-02-03	3033478	68
	3001955		T & B GSB 101	3002908	4			
	coax cable type 3		T & B GSC 187	3002912	7	T & B WT 206	3033459	69
	3001954		T & B GSB 124	3002909	5			
			T & B GSC 219	3004157	15	T & B WT 208-11	3033868	70
			T & B GBS 134	3004156	14			

TABLE 16. LUG AND CRIMPING TOOLS (Cont'd)

LUG				TOOL					
Type	Wire Size	Stud Size	Manuf. P/N	IBM P/N	Photo Ref.	Manuf. P/N	IBM P/N	Photo Ref.	Comments
Ferrule (cont.)			T & B GSC 287	3061094	39	T & B WT 214	3033458	71	
			T & B GSB 194	3061093	38				
	coax cable type 4 3212391		T & B GSC 312	3004931	19	T & B WT 235	3033867	70	
			T & B GSB 205	3004761	18				
			T & B GSC 327	3212121	61	T & B WT 235	3033867	70	
			T & B GSB 261	3004075	13				
Parallel Connector	16-14		Amp 34137	3003820	10	Amp 49900	3033483	62	
Plug	22-18		Hubble K-1121-B	3003666	9	Hubble 120Y-91	3033477	72	
Ring	22-16	#3 & 4	Amp 31878 loose Amp 41548 roll	3061071	35	Amp 49556	3033461	63	
Tongue		#3 & 4	Burndy YAE-18-N17 loose SE-18-N17 roll	3061071	35	Burndy MR8-33S	3033472	64	
Terminal		#4, 5, 6	Burndy YAE-18-G43 loose SE-18-G43 roll	3002876	2	Burndy MR8-33S	3033472	64	
		#6	Amp 31879 loose Amp 41170 roll	3061003	24	Amp 49556	3033461	63	
		#6	Amp 34110	3061072	36	Amp 49900	3033483	62	
		#8	Amp 31888 loose Amp 41102 roll	3061018	27	Amp 49556	3033461	63	

TABLE 16. LUG AND CRIMPING TOOLS (cont'd)

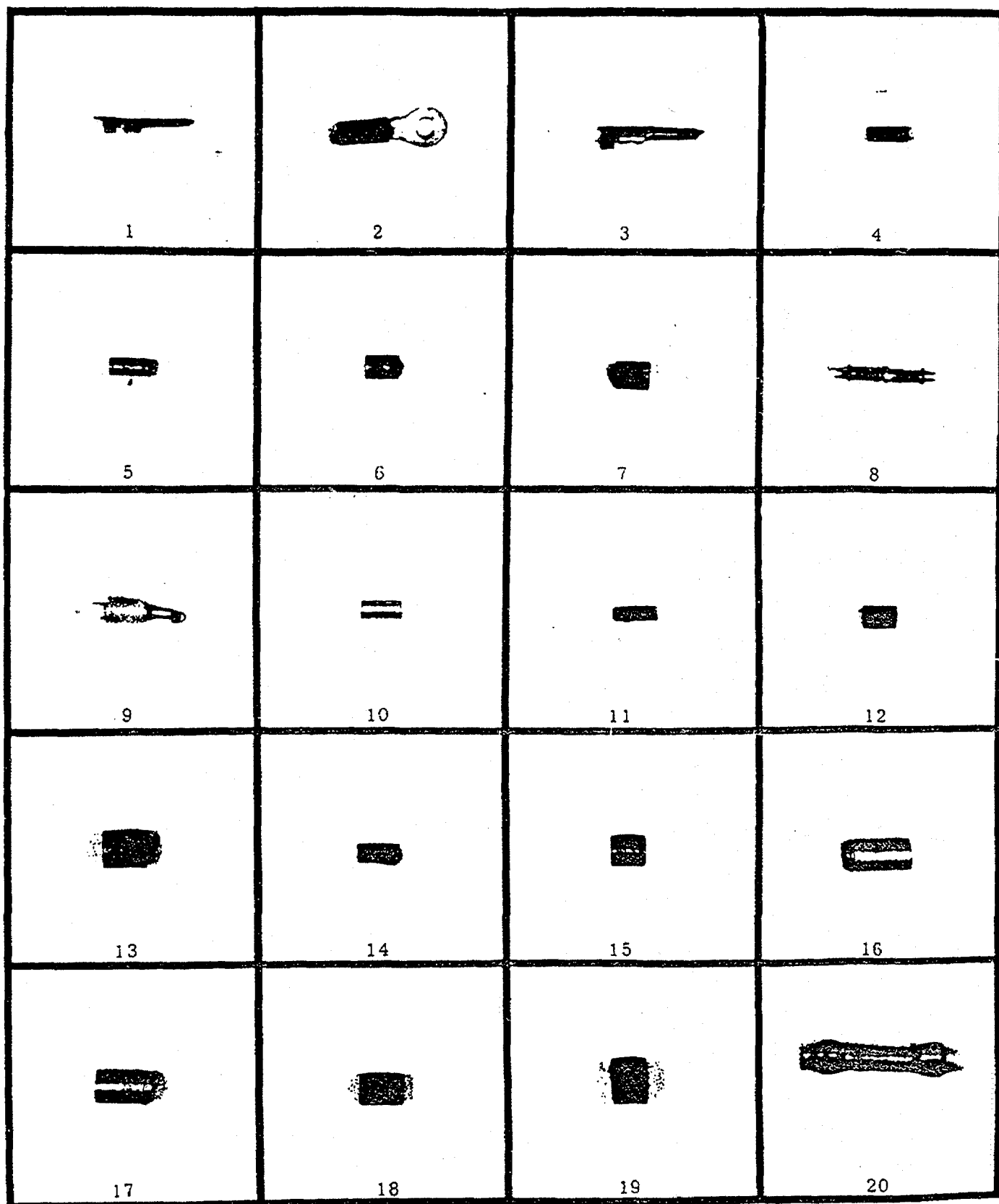
LUG										TOOL			
Type	Wire Size	Stud Size	Manuf. P/N	IBM P/N	Photo Ref.	Manuf. P/N	IBM P/N	Photo Ref.	Comments				
Terminal (cont.)		#8	Burndy YAE-18-N1 loose SE-18-N1 roll	3061018		Burndy MR8-33S	3033472	64					
		#10	Amp 31889 loose Amp 41103 roll	3061001	23	Amp 49556	3033461	63					
		#10	Burndy YAE-18-N loose SE-18-N roll	3061001	23	Burndy MR8-33S	3033472	64					
Ring	22-16	1/4"	Amp 31892 loose Amp 41172 roll	3061921	44	Amp 49556	3033461	63					
Tongue		1/4"	Burndy YAE-18-N2 loose SE-18-N2 roll	3061921	44	Burndy MR8-33S	3033472	64					
Terminal	16-14	#6	Amp 31898 loose Amp 41105 roll	3061005	25	Amp 49557 or Amp 49864	3033466 or 3033464	62 65					
(Cont'd)		#10	Amp 31900 loose Amp 41107 roll	3061006	26	Amp 49557 or Amp 49864	3033466 or 3033464	62 65					
		#10	Burndy YAE-14-N loose SE-14N roll	3061006	26	Burndy MR8-33S	3033472	64					
		1/4"	Amp 31904	3061025	31	Amp 49557 or Amp 49864	3033466 or 3033464	62 65					
	14	#6	Amp 32440 loose Amp 41314 roll	3061023	29	Amp 49557 or Amp 49864	3033466 or 3033464	62 65					
		#6	Burndy YAE-14-N43 loose SE-14-N43 roll	3061023	29	Burndy MR8-33S	3033472	64					
		#8	Amp 31899 loose Amp 41106 roll	3061020	28	Amp 49557 or Amp 49864	3033466 3033464	62 65					
		#8	Burndy YAE-14-N1 loose SE-14-N1 roll	3061020	28	Burndy MR8-33S	3033472	64					

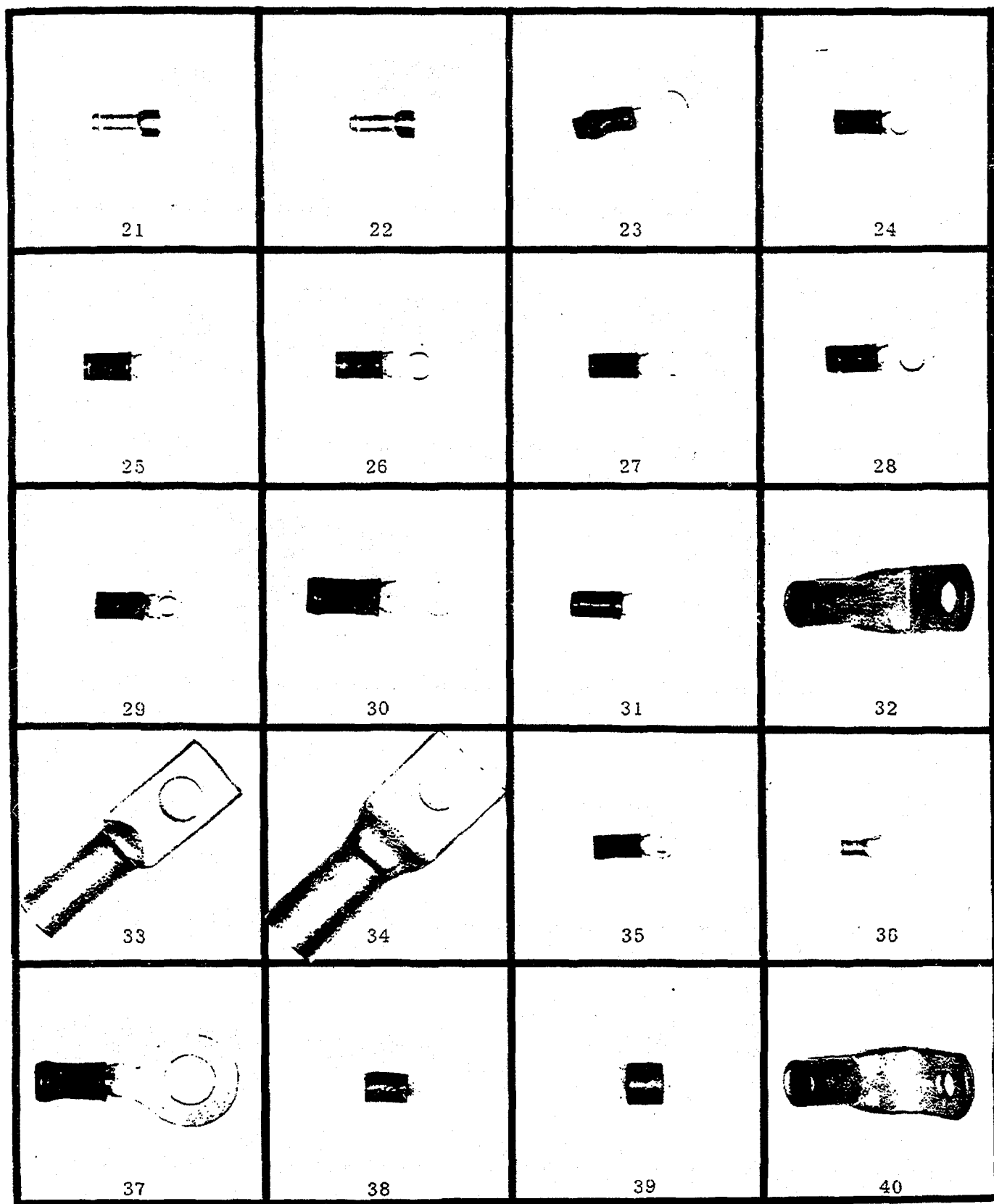
TABLE 16. LUG AND CRIMPING TOOLS (Cont'd)

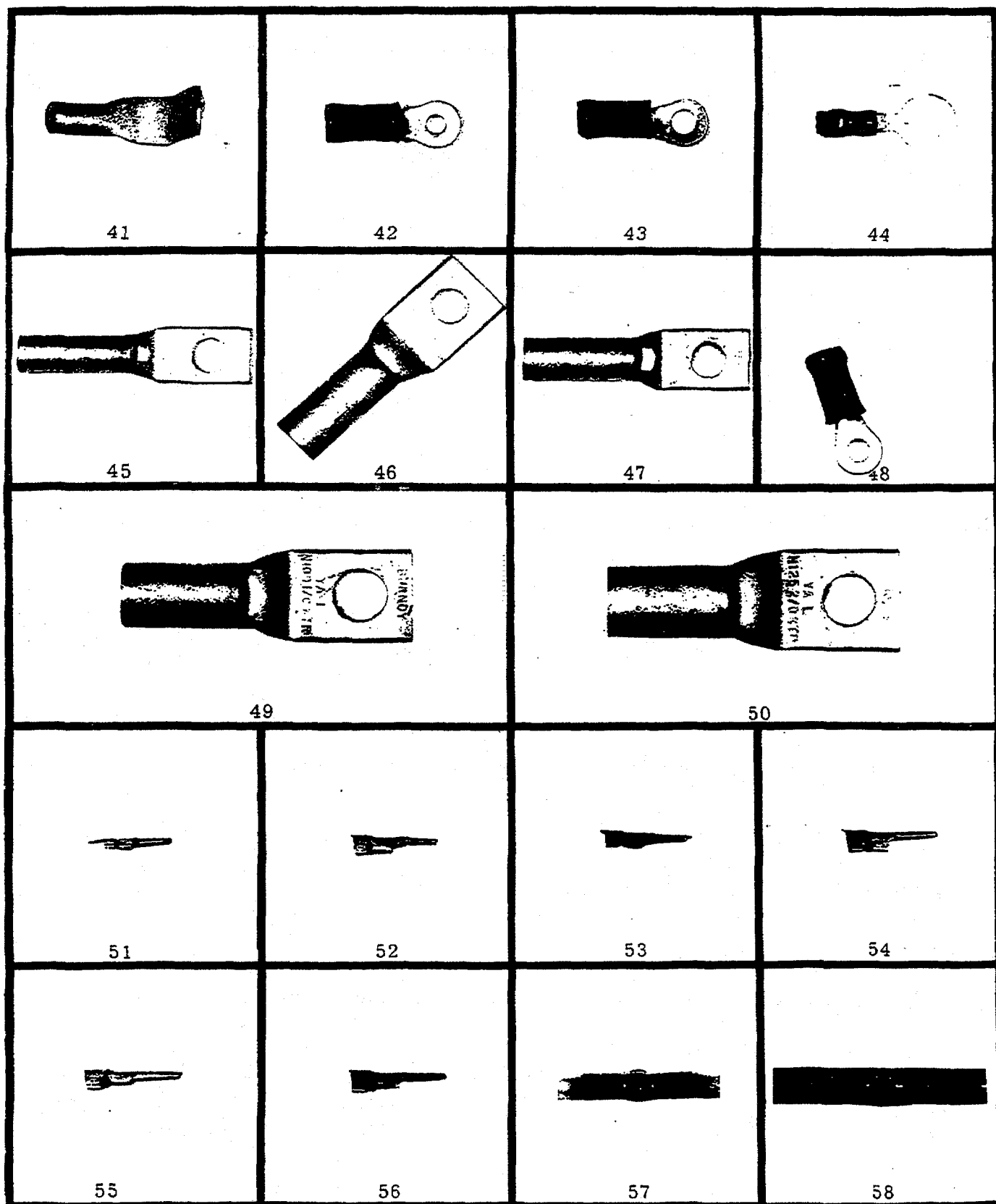
LUG				TOOL						
Type	Wire Size	Stud Size	Manuf. P/N	IBM P/N	Photo Ref.	Manuf. P/N	IBM P/N	Photo Ref.	Comments	
Terminal (cont.)	12-10	#6	Amp 32542 loose Amp 41050 roll	3061899	42	Amp 59062	3033467	62		
		#8	Amp 32543 loose Amp 41051 roll	3061948	48	Amp 59062	3033467	62		
		#10	Amp 32544 loose Amp 41052 roll	3061900	43	Amp 59062	3033467	62		
		1/4"	Amp 32545	3061024	30	Amp 59062	3033467	62		
		3/8"	Amp 32547	3061089	37	Amp 59062	3033467	62		
Ring	8	#8-10	Burndy YAV8CRS	3061896	41	Burndy MY29	3033471	73		
	6	1/4"	Burndy YA-6C-L	3061928	45	Burndy MY29	3033471	73		
	4	#8-10	Burndy YAV4C-RS3	3061894	40	Burndy MY29	3033471	73		
Tongue	4	1/4"	Burndy YAV4C-RS	3061026	32	Burndy MY29	3033471	73		
	4	1/4"	Burndy YA-4C-L	3061929	47	Burndy MY29	3033471	73		
Terminal	2	1/4"	Burndy YA-2C-L2	3061930	46	Burndy MY29	3033471	73		
	2	5/16"	Burndy YA-2C-L	3061069	33	Burndy MY29	3033471	73		
	1	5/16"	Burndy YA25-L	3061070	34	Burndy MY29	3033471	73		
	1/0	3/8"	Burndy YA-25-L4	3061944	49	Burndy MY29	3033471	73		
	2/0	3/8"	Burndy YA-26-L	3061945	50	Burndy MY29	3033471	73		
	26-22		Amp C-41278	3090156	51	Amp 48698	3033479	62		
	22		Amp 42153-1	3208057	60	Amp 47745	3034146	74		
	22-18		Amp 42031-0	3002762	1	Amp 47450	3033468	62		
	Taper Pin									

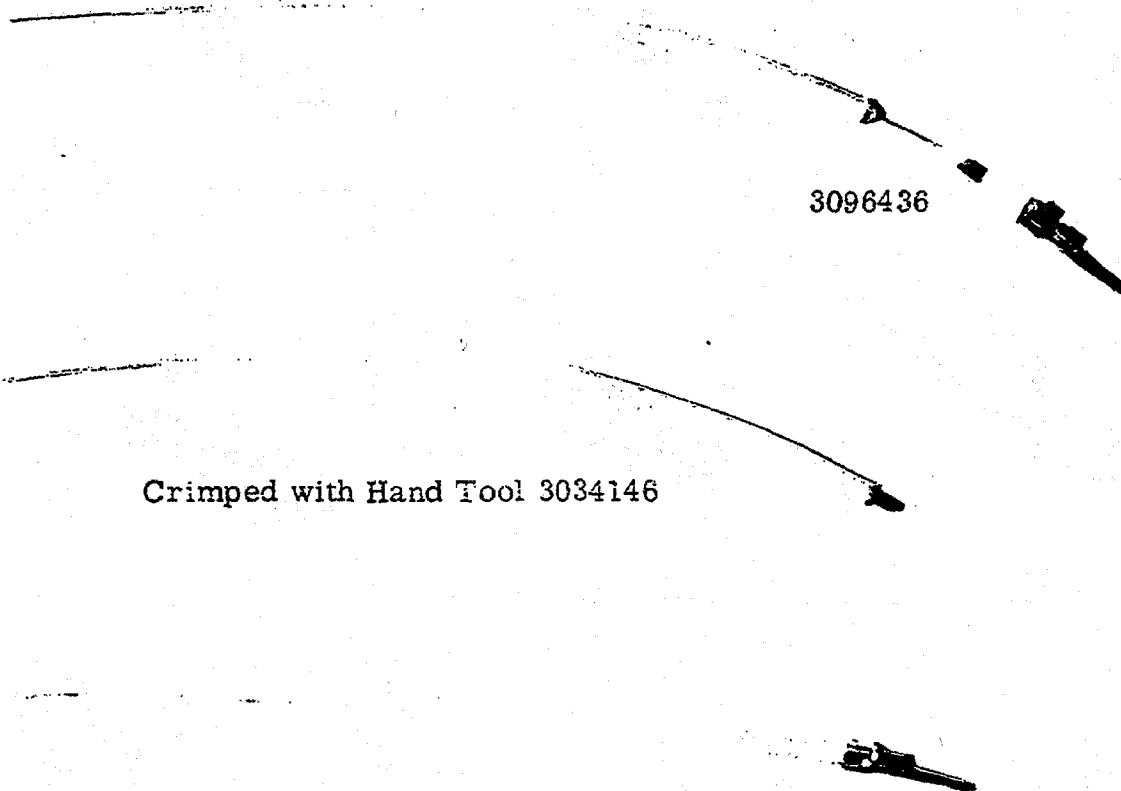
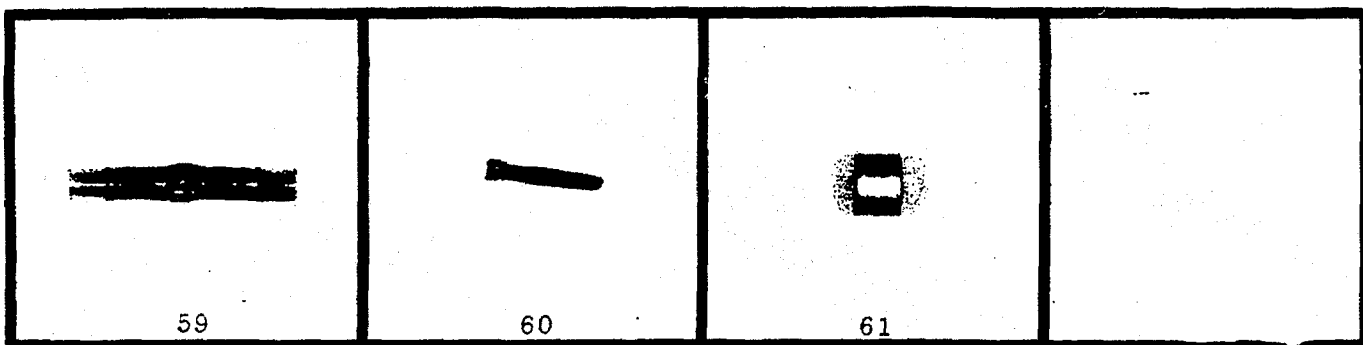
TABLE 16. LUG AND CRIMPING TOOLS (Cont'd)

LUG					TOOL				
Type	Wire Size	Stud Size	Manuf. P/N	IBM P/N	Photo Ref.	Manuf. P/N	IBM P/N	Photo Ref.	Comments
Taper Pin (cont.)	22-18		Amp C-41650	3095837	53	Amp 47043	3033480	62	
	20-16		Amp 41608	3002877	3	Amp 47194	3033462	62	
	18-16		Amp 42147-1	3097086	55	Amp 47194	3033462	62	
	16		Amp C-41656	3095836	52	Amp 47044	3033482	62	
	16-14		Amp 42090-1	3096435	54				
	16-14		Amp C-42148-1.	3097087	56	Amp 47745	3034146	74	









The inner conductor of a coaxial cable is too thin to be inserted directly into a taper pin and still have a good crimp. In these instances, stuffer (P/N 3096436) is used to build up the diameter of the inner conductor.

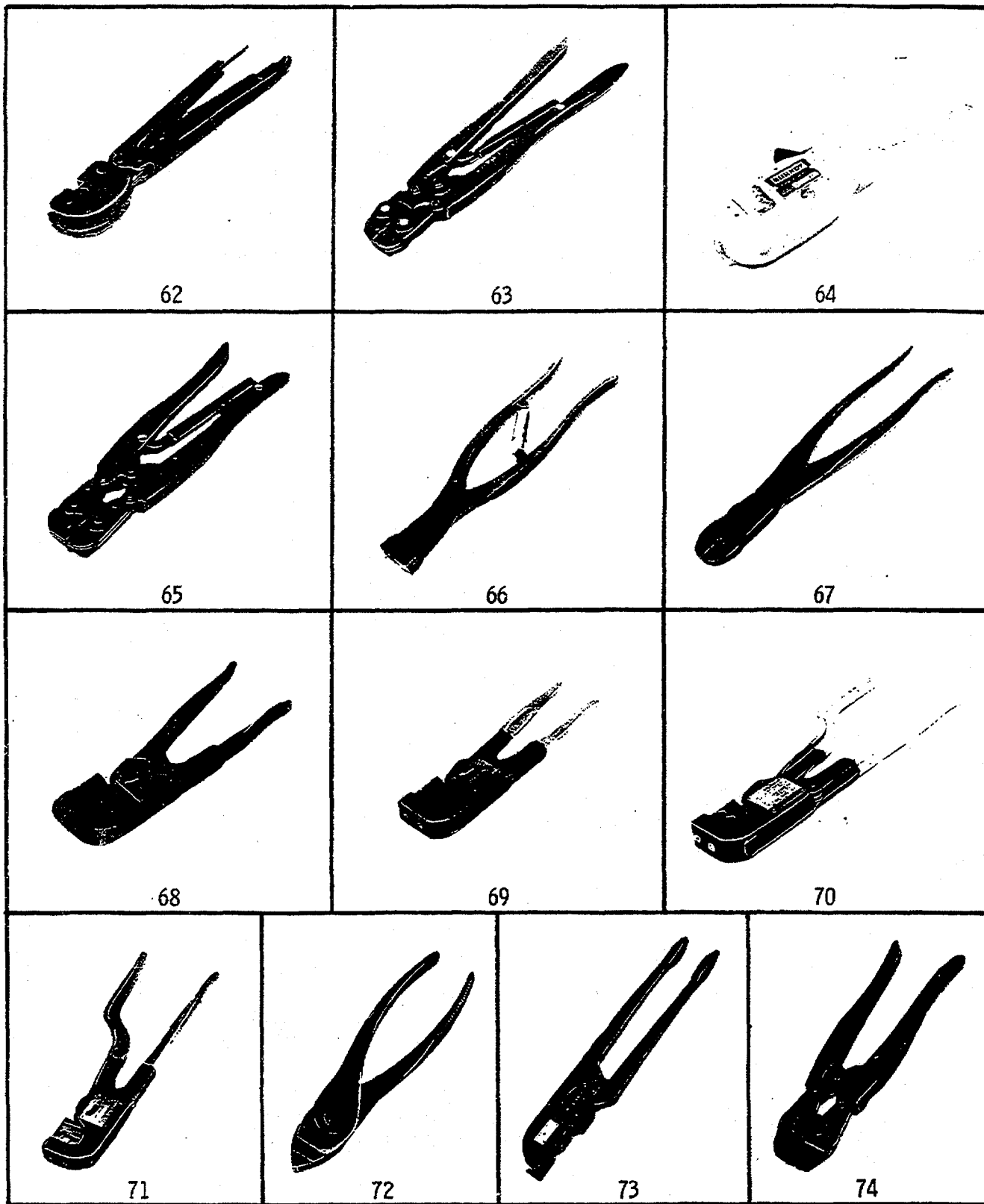
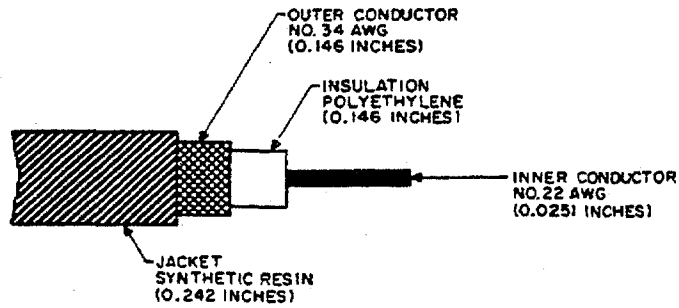
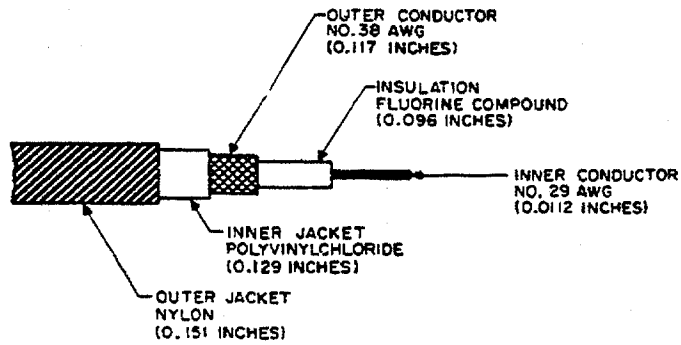




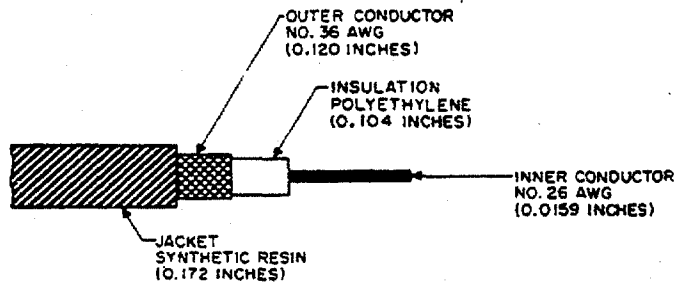
TABLE 17. COAXIAL CABLES



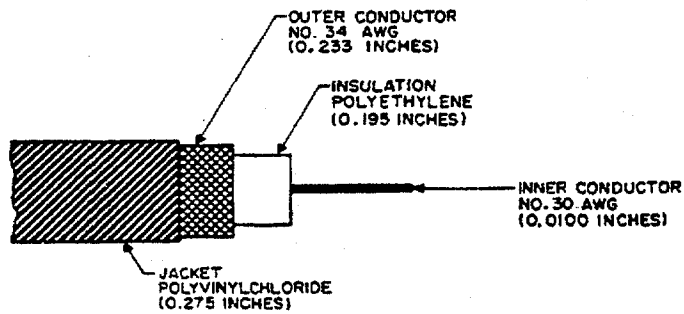
TYPE I (P/N 3001953)



TYPE II (P/N 3001955)



TYPE III (P/N 3001954)


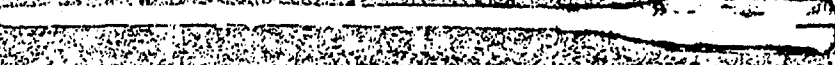



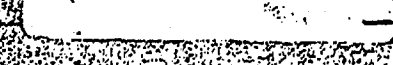






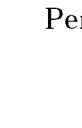


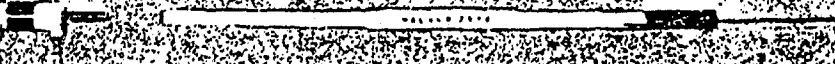



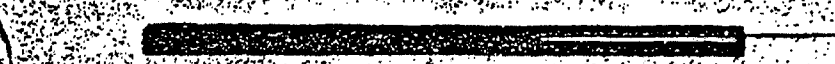


TYPE IV (P/N 3212391)

TABLE 18. ADJUSTMENT TOOL KIT

IBM P/N	VENDOR P/N	DESCRIPTION
3135058	8273	Plastic handle and shaft with very thin recessed spring steel tip. Length - 8"
3135059	8279	Recessed steel milled slot. Length - 7-1/2"
3135060	8272	Plastic handle and steel shaft with extra-thin spring steel screwdriver blade. Length - 6-1/2"
3135061	8195	Completely insulated with 1/8" long narrow blade. Overall length - 7-1/4"
3135062	5080	Insulated handle with 1/8" square socket wrench. Length - 6"
3135063	8274	Extra-thin white plastic blade. Length - 9"
3135064	8606	Plastic, hex wrench on both ends; one end is undercut. Length may be 5" or 11"
3135065	8278	Plastic tuning wand. Length - 6"
3135066	5097	Plastic with screwdriver tip on both ends. One tip is plastic; the other, metal. Length - 6"
3135067	8282	Molded plastic with plastic hex wrench on one end and a small screwdriver tip on the other. Length - 5-7/16"
3135068	8277	Plastic with extra-thin spring steel tips. One end is projected; the other, recessed. Length - 2-1/2"
3135069	8279	Plastic handle with recessed steel slot. Length - 7-1/2"
3135070	5066	Short tuning tool with metal screwdriver blade. Length - 2-1/2"
3135071	8275	Plastic with thin plastic screwdriver tip on one end and a recessed steel tip on the other. Length - 5"
3135072	8271	Plastic with a steel insert on one end and a thin screwdriver blade on the other. Length - 6"
3135073	8276	Plastic with steel tips. One end has a projected tip; the other end is recessed.

TABLE 19. KIT P/N 3135040

COMPONENT*	TOOL DESCRIPTION	P/N	VENDOR
		3135049	003-001
		3135048	003-000
		3135052	003-006
		3142416	003-307
		3142417	003-334
		3142414	003-304
		3142415	003-305
		3135050	003-003
		3142413	003-301
		3135051	003-004

\*This column indicates the component within the test equipment on which the alignment tool is used.  
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